Understanding the Role of Demographic, Perceptual and Personality Factors in the Use of Mobile Data Services

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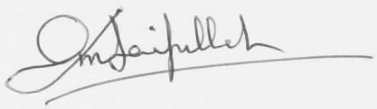
Except where otherwise indicated, this thesis is my own original work.



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ABSTRACT

Conventional telecommunication technologies, characterised by wires and fixed locations, are rapidly giving way to mobile data services (MDSs). Recent technological developments have opened up possibilities for various applications of MDSs. This thesis specifically focuses on two promising MDS applications: mobile banking (m-banking) and mobile learning (m-learning). It signifies an important step in the testing of theories related to demographics, perceptions and personality traits in the use of MDSs, through three studies.

In Study 1, which examines the digital divide in the use of MDSs, I analyse the effects of gender and age differences on the usage of MDSs. An online survey was disseminated in the United Kingdom (UK), and completed responses were received from 2,000 mobile phone users and non-users on both sides of the divide (i.e., with or without access to mobile information and communication

technologies (ICTs)). I developed eight hypotheses and used logistic regression and chi-square tests to test them. My findings demonstrate that men are more likely than women to use MDSs, and that young people are more likely than their older counterparts to use MDSs. The study contributes to the literature on MDSs by highlighting the issue of the digital divide. The study also provides insights to MDS providers and policymakers on how to develop and promote MDSs for different socio-demographic groups.

In Study 2, I examine m-banking which is regarded as a killer application amongst all MDSs. This study has two parts. In Study 2 (Part I), I present a literature review of, and a classification framework for, the existing m-banking literature. Sixty-five articles related to m-banking were published in major journals and presented at conferences between January 2000 and June 2010. They belong to various disciplines, including information systems (IS), technology innovation, management and marketing. Study 2 (Part I) classifies these articles into five main categories: (1) m-banking overview and conceptualisation; (2) m-banking applications and cases; (3) m-banking behaviour; (4) m-banking infrastructures; and (5) m-banking strategic, legal and ethical issues. Several new research questions that could yield valuable results in the m-banking field are given, including a fundamental question on

users' switching behaviour from other banking channels to m-banking which is examined in further detail in Study 2 (Part II).

In Study 2 (Part II), I develop a model that is anchored by expectancy theory and validate it using data collected from 493 mobile phone users in order to predict intentions to switch to m-banking. I chose the m-banking context because recent advances in mobile devices have made m-banking an attractive option for banks and mobile service providers; however, consumer demand for m-banking is low. The findings suggest that perceived mobility, relative advantage and self-efficacy are positively related to user intentions to switch banking channels. Perceived complexity is negatively related, whereas perceived financial resources and risk are not related to intentions to switch.

Study 3 examines another key MDS, m-learning which proposes to use a text messaging service as a tool to stimulate learners' activities. It examines whether learners' personalities influence their reactions to accessing course materials through m-learning messages. The Myers-Briggs Type Indicator (MBTI) was used to categorise learners into different personality groups. After conducting a field study with 217 students, it was found that learners of different personalities showed different levels of activities when receiving m-learning messages.

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ABBREVIATIONS

ACM	Association for Computing Machinery
ATM	Automated Teller Machine
AVE	Average Variance Extracted
DV	Dependent Variables
HCI	Human–Computer Interaction
ICT	Information and Communication Technology
IS	Information Systems
IV	Independent Variables
MBTI	Myers-Briggs Type Indicator
MDS	Mobile Data Service
MIPS	Millon Index of Personality Styles
MIS	Management Information Systems
MIT	Massachusetts Institute of Technology
MMS	Multimedia Messaging Service
PDA	Personal Digital Assistant
PLS	Partial Least Square
RFID	Radio Frequency Identification

SMS	Short Messaging Service
SST	Self-Service Technology
UK	United Kingdom
US	United States
WebCT	Web Course Tools
WLAN	Wireless Local Area Network
ZMET	Zaltman Metaphor Elicitation Technique

FIGURES

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Chapter 1

Introduction

Conventional telecommunication technologies, which are characterised by wires and fixed locations, are rapidly giving way to mobile data services (MDSs) (Lee et al. 2009). MDSs refer to the convergence of mobile communication technologies with information and data communication services (ITU 2002). It is an assortment of data communication services that can be accessed using mobile handheld devices over a wide geographic area via mobile networks (Hong and Tam 2006).

Recent advances in wireless technologies and proliferation of mobile phones have all been advantageous to the adoption of MDSs. Studies of mobile commerce suggest that there is a general consumer interest in the use of MDSs (Mallat et al. 2009). Many mobile telecommunication companies and MDS providers are trying to tap into this interest by offering a variety of MDSs to their customers (Kim and Han 2009), as there has been a steady decline in average returns per user from the voice market (Funk 2007).

MDSs are technically ready (Dahlberg et al. 2008, Nickerson 2008), and recent technological developments have opened up new possibilities for various applications of MDSs. The two most promising MDS applications at present are mobile banking (m-banking) and mobile learning (m-learning).

M-banking refers to technology-mediated banking services provided via mobile telecommunication devices such as mobile phones and Personal Digital Assistants (PDAs) (Mallat et al. 2004). It is a new channel that supports and enhances existing banking services. Typical m-banking functions include viewing account balances, transferring funds from one account to another, receiving alerts and paying bills.

M-learning refers to the acquisition of knowledge and skills through use of mobile technology anywhere and anytime (Liu et al. 2010). It adds a new dimension to the traditional learning methods. It facilitates a cost-effective, self-paced and interactive learning environment (Zhang and Nunamaker 2003).

The offering of MDSs such as m-banking services to increasingly mobile consumers, and m-learning to modern-day learners, may seem attractive to businesses, but it is the users who ultimately decide whether or not to accept them and the level of user acceptance of MDSs to date has been lower than expected (Kim et al. 2009). MDSs have so far become popular only in a few countries such as Japan, South Korea and Finland (Baldi and Thaung 2002).

Unfortunately our understanding of the acceptance of MDS applications by the users is far from conclusive. Little research has been conducted, for example, on how MDSs attract users to switch from other channels to a mobile channel

for their banking needs. Similarly, minimal research has been conducted on m-learning (Ngai and Gunasekaran 2007), and there appears to be no prior research that examines the role of learners' personalities on m-learning. Not surprisingly, there have been many calls in recent years for more studies on the use of MDS applications (Blechar et al. 2006, Ngai and Gunasekaran 2007, Dwivedi et al. 2008, Kim et al. 2009). This thesis is motivated from these calls and it aims to provide much-needed insight to MDS providers.

This thesis examines the effects of demographic, perceptual and personality factors on the adoption and use of m-banking and m-learning. These two promising MDS applications have been chosen because m-banking is 'transaction-focused' and m-learning is 'infotainment-focused'. Many major banks around the globe are offering m-banking delivery channels (Sharma and Gutiérrez 2010), and m-banking is expected to be a 'killer application' in the current decade (Economist 2007). In terms of m-learning services, it can facilitate increasingly mobile and modern-day learners who are constantly 'on the move' by accommodating diverse learning environments such as homes, offices, offsite locations, and meeting rooms. The choice of two MDS contexts, being m-banking and m-learning, also provides the opportunity to use both survey and field study methods to collect quantitative data for the thesis.

This thesis is based on three studies that have been reported in four research articles, and as part of these three studies, a total of 20 hypotheses have been tested. Study 1 examines the digital divide in respect of usage of various MDSs through the effects of socio-demographic factors, and is presented in Chapter 2. Study 2 focuses on a key MDS application - m-banking - and is divided into 2 parts. Part I of Study 2 (Study 2 (Part I)) presents a literature review of, and a classification framework for, the existing m-banking literature, and is described in Chapter 3. Part II of Study 2 (Study 2 (Part II)) examines the important issue of behavioural intention to switch from other banking channels to m-banking, and is presented in Chapter 4. Study 3 deals with another key MDS application - m-learning. It examines the effects of learners' personality traits on intention and behaviour towards the use of m-learning, and is presented in Chapter 5. The outline of each of these three studies is set out in further details below, and Figure 1.1 below provides a flow diagram of the overall structure of the thesis.

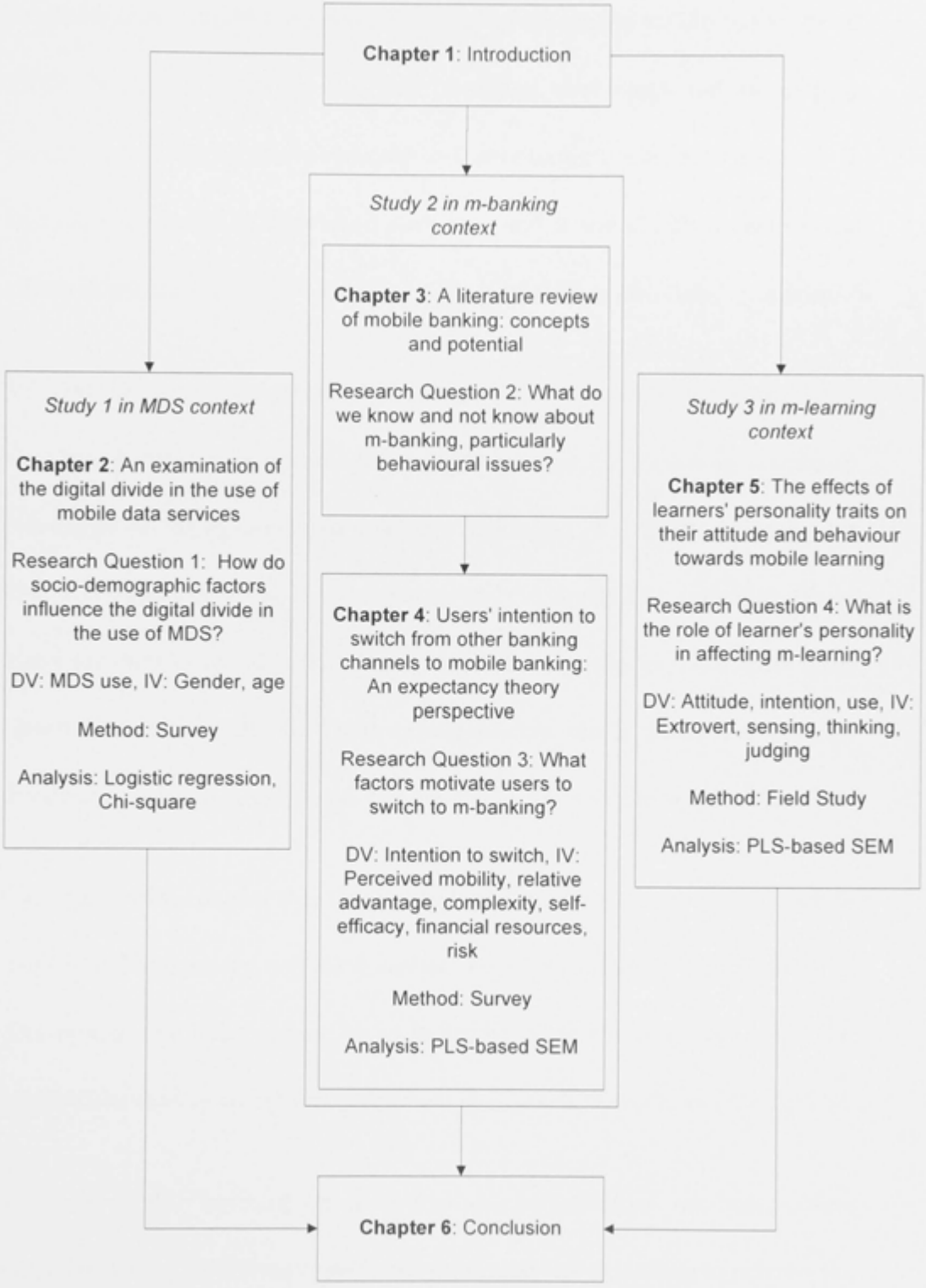


Figure 1.1: Thesis structure

As stated above, Study 1 examines the issue of the digital divide in the use of MDSs. Such divide exists not only between developed and developing countries, but also within developed and developing countries. This study is limited in its scope to developed countries, and it specifically examines the effects of gender and age on the use of different MDSs in developed countries.

MDS practitioners want to narrow the digital divide in use of different MDSs, but there is little research examining socio-demographic factors in context of this digital divide in developed countries (DiMaggio et al. 2004, Akiyoshi and Ono 2008, Ladd et al. 2010). In other words, the divide that separates people based on their usage of MDSs has so far received inadequate attention from researchers, despite the fact that mobile phones reach nearly everyone in developed countries (Dewan and Riggins 2005, Chircu and Mahajan 2009).

Some researchers suggest that the digital divide is different in the use of mobile devices and computers, and some researchers predict that the digital divide is determined, to a lesser extent, by socio-demographic characteristics in mobile applications than in computers (Wareham et al. 2004, Akiyoshi and Ono 2008).

In Study 1, by focusing on demographic characteristics (as independent variables (IV)), I have tried to get a more nuanced understanding of motives for MDSs usage (as dependent variables (DV)) among various demographic groups.

The study addresses the following question: How do socio-demographic factors influence the digital divide in the use of MDSs? The study contains eight hypotheses that are tested using data from an online survey of 2,000 users and non-users of MDSs, which was conducted in the United Kingdom (UK). The findings of the study are important for the purposes of tailoring MDSs to different socio-demographic groups, thereby increasing the likelihood of MDSs use.

Study 2 examines the issue of m-banking and is divided into 2 parts. Study 2 (Part I) presents a literature review of m-banking, and as part of the review, I survey and synthesise articles in the area of m-banking that were published between January 2000 and June 2010.

Researchers are interested in why bank customers adopt m-banking (Yang 2009); however, little work has been conducted on other m-banking issues, despite calls from senior scholars for more research in this area (Venkatesh 2006, Curran and Meuter 2007, Nickerson 2008). The research on m-banking to date has been fragmented; it lacks a roadmap and an agenda, and there appears to be no review of m-banking in existence. Hence, the review article in Study 2 (Part I) examines the following question: What do we know and not know about m-banking, particularly in respect of behavioural issues? The study has

the aim to identify trends and patterns and to reveal our progress as a research community in m-banking. It is a timely review as users have already experienced a decade of the m-banking phenomenon.

Study 2 (Part II) focuses on one key aspect of m-banking, that is, the users' intentions to switch from other banking channels to m-banking. Prior research generally considered m-banking as a standalone application, neglecting the fact that m-banking is only one service in a bundle of banking services and signing on to m-banking usually requires a user to switch from one form of banking service to another. Bank account holders may also perform their banking functions via multiple channels. Therefore, research that regards m-banking as a standalone application fails to see the overall picture of how users access banking services. There have been calls in recent years for more research to understand the switch of current bank users from other channels (e.g., branch) to emerging self-service technology (SST) channels (Venkatesh 2006, Curran and Meuter 2007). This understanding is particularly important for bank executives who are keen to get an insight into user acceptance of technology-mediated m-banking (Lyytinen and Youngjin 2002). Study 2 (Part II) intends to address this. It answers the following research question: What factors motivate users to switch to m-banking? In answering the question, it considers the m-banking application as a part of the bundled services provided by service

providers. It treats the issue of adopting m-banking as a channel-switching problem, and examines why users move from their current channel (e.g., Internet banking) to a new mobile channel. It recognises that, even though m-banking may support typical functions such as viewing account balances and transferring funds from one account to another, it cannot fully replace physical branches or automated teller machines (ATMs) for all banking functions. The study uses the expectancy theory (Vroom 1964) to develop the research model and contains six hypotheses that are tested using survey data from 493 participants.

Study 3 examines the effects of learners' personality traits on their attitude and behaviour towards m-learning. Prior research in education supports a general idea that learning environments are more effective if they capitalise on the characteristics of both learning tasks (i.e., reading course materials or participating in a discussion forum), and the individual characteristics (i.e., personality). However, scant research examines the effects of learners' personalities, and in particular, there is lack of research that analyses the effects of learners' personalities on m-learning. Study 3 addresses the following two questions: (1) What are the effects of text messaging on stimulating learners to access course materials? (2) What is the role of the personality in affecting learners' responses to m-learning messages? Study 3 proposes a model

containing six hypotheses. The Myers-Briggs Type Indicator (MBTI) has been used to conduct a field study of 217 Web Course Tools (WebCT) learners over 10 weeks, in order to test the six hypotheses.

The remainder of this thesis proceeds as follows. Section 2.1 of Chapter 2 provides the background of Study 1 on the digital divide in the use of MDSs. This is followed by a review of the literature on MDSs and the digital divide in Section 2.2. Section 2.3 provides a description of the study hypotheses, which is followed by methodologies in Section 2.4 and findings in Section 2.5. A discussion of the findings, their practical implications and their limitations is presented in Section 2.6, while Section 2.7 presents a summary of Study 1.

Chapter 3, which presents a literature review on m-banking, begins with the background of Study 2 (Part I) in Section 3.1. Section 3.2 describes the methodology used and Section 3.3 presents the criteria used for classifying the m-banking literature. The results of the analysis are set out in Section 3.4, followed by a discussion in Section 3.5, Section 3.6 presents limitations and Section 3.7 presents a summary of Study 2 (Part I).

Chapter 4, which presents a study on users' intentions to switch from other banking channels to m-banking, begins with the background of Study 2 (Part II) in Section 4.1. Section 4.2 introduces expectancy theory as the theoretical

frame of Study 2 (Part II). Section 4.3 describes the proposed model and the resulting hypotheses. Section 4.4 presents methodology and Section 4.5 discusses the findings. Section 4.6 discusses the theoretical contributions and practical implications of Study 2 (Part II) and its limitations. Section 4.7 presents a summary of Study 2 (Part II).

Chapter 5, which presents a study on the effects of learners' personality traits on their attitude and behaviour towards m-learning, begins with the background of Study 3 in Section 5.1. Section 5.2 reviews the literature on learning, learners' personalities and MBTI personality types in order to shed light on the personalisation of m-learning to learners' personalities. Section 5.3 describes the hypotheses of Study 3. Section 5.4 details the field study on m-learning, the findings of which are presented in Section 5.5. Section 5.6 discusses the theoretical contributions and practical implications of Study 3 and its limitations. A summary of Study 3 is presented in Section 5.7.

Chapter 6 concludes the thesis in which concluding remarks are presented for each of the three studies, followed by a summary of the theoretical contributions and the practical implications of the thesis.

Chapter 2

An Examination of the Digital Divide in the Use of Mobile Data Services

2.1 Background of the Digital Divide

The term 'digital divide' refers to differences in the amount and patterns of technology usage due to the gap between people who have access and skills to use information and communication technologies (ICTs) and those who do not (OECD 2001, Buente and Robbin 2008, Talukdar and Gauri 2011). This divide reinforces inequalities in opportunities for the use of ICTs, economic development and social participation (DiMaggio et al. 2004).

Dewan et al. (2005) suggest that there is a changing nature in the divide across successive generations of ICTs such as computers and the Internet. The latest statistics from Eurobarometer reveal the existence of the digital divide between people of different genders and ages in European countries (Van Dijk 2009). Although gender and age gaps in respect of the possession of computers have been closing in recent years, these gaps differentiate usage patterns (Van Dijk and Hacker 2003, Bae and Lee 2010).

In the context of computer applications, recent studies suggest that a higher proportion of men than women regularly use computers for personal use (Seybert 2007, Eurostat 2010). For instance, a survey conducted in Europe in 2006, among people aged 16–74, found that 48% of men and 39% of women reported using a computer at least once a day during the preceding three

months (Seybert 2007). The gap between men and women was even wider for basic computer skills than for computer usage (Seybert 2007). Nearly half of young men (48%) aged 16–24 were considered to have high computer skills, compared to 30% of women (Seybert 2007). Similar results were noted among older age groups, where 34% of men and 18% of women aged 25–54, and 12% of men and 3% of women aged 55–74, were considered to have high computer skills. There is no indication that the gap will disappear anytime soon due to the rather difficult goal of universal access to, and use of, computers (Van Dijk 2009, Helsper 2010).

The digital divide is also evident in the context of Internet usage (Buente and Robbin 2008). In Europe, the average proportion of men using the Internet is 38%, compared to 28% of women (Seybert 2007). Further, according to Howard et al. (2001), men and women search for different content on the Internet. Women tend to use the Internet more for social activities, while men tend to search for utilitarian information (Brynin and Kraut 2006). In addition, women prefer e-mailing for relationship building and were less likely to read news and buy products online (Buente and Robbin 2008). Further, in European population aged 16–74, 37% of men used the Internet for government services in 2007, compared to 31% of women (Seybert 2007). In 2010, the gap remained the same as in 2007 (6%), with 38% of men and 32% of women using e-

government services (Eurostat 2010). Interestingly, the gap was the same in the UK, with 43% of men and 37% of women using e-government services in 2010 (Eurostat 2010).

The digital divide occurs at the global level or at the domestic level, that is, within a country (Norris 2001, Vicente Cuervo and López Menéndez 2006). Some studies on the global-level digital divide have compared the penetration of ICTs among different countries using an array of socio-economic indicators such as gross domestic product, income, education, telecommunication infrastructure, telecommunication costs, computing costs, human resources, regional orientation and trade (Dewan and Riggins 2005, Dewan et al. 2009). Other studies have compared the use of ICTs between countries, for example, between India and the Philippines (Zainudeen et al. 2010), China and the UK (Li and Kirkup 2007), and Norway and Spain (Brandtzæg et al. 2011). Dewan et al. (2005) examined a panel of 40 countries based on 1985–2001 data from three distinct generations of ICTs (i.e., mainframes, personal computers and the Internet), and found evidence of the digital divide in ICT use between developed and less developed countries. They examined developed countries such as Denmark, Germany, Sweden, the UK and the USA, and developing countries such as China, India and Thailand. Kauffman and Techatassanasoontorn (2005) collected data from 25 developed and 18

developing countries and found that faster growth of digital wireless phones occurs when a country has a well-developed telecommunications infrastructure, competition in the wireless market, low wireless network access costs and few wireless technology standards. Stump (2008) studied country-level aggregate data on the age, education and wealth of 170 developing and developed countries and found evidence of the influence of wealth on mobile phone adoption.

The literature on the domestic (within a country) digital divide examines why some individuals are not able to access ICTs. Researchers have examined the issue of the digital divide in countries such as the US (Dholakia 2006, Kvasny and Keil 2006, Sipior et al. 2011), China (Fang and Yen 2006), Japan (Akiyoshi and Ono 2008), the UK (Stewart 2000) and Lebanon (Harfouche and Robbin 2010). Their studies list various factors leading to the digital divide including age, gender, income, level of education, race, socio-economic status, place of residence, adeptness with technology and social associations. Several studies have suggested that socio-demographic factors influence the digital divide (OECD 2001, Akiyoshi and Ono 2008, Harfouche and Robbin 2010, Talukdar and Gauri 2011). Akiyoshi and Ono (2008) found lower socio-economic barriers in Japan for accessing the Internet on mobile phones compared to

computers. Harfouche and Robbin (2010) found that a Lebanese individual's age influenced electronic access and skills in using e-government services.

While several researchers found no significant difference in Internet usage between males and females (Wareham et al. 2004, Akiyoshi and Ono 2008), many found that gender played a significant role in affecting technology use (OECD 2001, Harfouche and Robbin 2010, Talukdar and Gauri 2011). In addition, Talukdar and Gauri (2011) found a digital divide between socio-economic fault lines (i.e., an urban–rural divide), while DiMaggio et al. (2004) found age and gender to be important determinants of a digital divide. Gefen and Straub (1997) evinced that men and women differ in their perceptions of e-mails, while Venkatesh and Morris (2000) found gender differences in motives for using new information systems (IS). Thus, the results of socio-demographic factors, such as gender effects on technology use, are inconsistent, and imply a concern that introducing new ICTs may reinforce existing socio-demographic inequalities, if the digital divide is not properly understood.

In summary, the digital divide remains substantial within most countries, and is widening even though the number and percentage of ICT users is increasing, as new users are demographically similar to those already using the same technology (Chen and Wellman 2004). Thus, the digital divide is arguably the

largest segregating force in the modern world (Sipior et al. 2011). Individuals on the wrong side of the digital divide cannot enjoy the benefits of ICTs and might be excluded from knowledge-based societies and economies (Chen and Wellman 2004). If addressing the digital divide is not a national priority, a generation will mature without ICTs - a generation that could otherwise be a key contributor to the future of a country (Seybert 2007, Sipior et al. 2011). Hsieh et al. (2008) suggested in this regard that it would be worthwhile to investigate relationships of different types, and the purposes of technology usage with different digital divide factors.

Study 1 examines the issue of the digital divide in the context of one of the most recently developed technologies, MDSs. It specifically examines the effects of gender and age on the use of MDSs. MDSs, as explained earlier in the thesis, refer to the convergence of mobile communication technologies with information and data communication services (ITU 2002). They are an assortment of data communication services that can be accessed using mobile handheld devices over a wide geographic area through mobile networks (Hong and Tam 2006). Though gender and age are widely studied socio-demographic variables, such studies took place in contexts other than MDSs and hence, they were chosen for this study.

This study examines the problem of the digital divide in MDSs for three reasons. First, despite an increasing interest among MDS practitioners to narrow the digital divide, there is little research examining the digital divide in the use of MDSs across socio-demographic groups within developed countries (DiMaggio et al. 2004, Akiyoshi and Ono 2008, Ladd et al. 2010). In other words, the divide that separates people based on how they use MDSs has received inadequate attention from researchers, despite the fact that mobile phones reach nearly everyone in developed countries (Dewan and Riggins 2005, Chircu and Mahajan 2009). Second, some researchers suggest that the digital divide is different in the use of mobile devices and computers, and some researchers predict that the digital divide will be determined by socio-demographic characteristics in computers and, to a lesser extent, in mobile applications (Wareham et al. 2004, Akiyoshi and Ono 2008). This study searches for empirical evidence to justify this prediction. Third, by focusing on personal and socio-demographic characteristics, it will be possible to gain a better understanding of the motives for MDS usage among various socio-demographic groups. Based on such understanding, MDSs can be tailored to different socio-demographic groups, thereby increasing the likelihood of MDS usage.

In this Study, the following question is addressed:

How do socio-demographic factors influence the digital divide in the use of MDSs?

Section 2.2 of this chapter presents a review of the literature on MDSs and the digital divide. This is followed by a description of the study hypotheses in Section 2.3, methodologies in Section 2.4 and findings in Section 2.5. A discussion of the findings, their practical implications and limitations is presented in Section 2.6. Section 2.7 presents a summary of this study.

2.2 Literature Review

2.2.1 Mobile Data Services

MDSs include information and data communication services that rely on mobile communication platforms (ITU 2002). MDSs can be used for basic tasks (such as text messaging, e-mail and streaming media), and for sophisticated applications (such as obtaining real-time information on local news, stocks and weather, or for downloading calendars and games) (Chircu and Mahajan 2009).

Chircu and Mahajan (2009) suggested that the digital divide for MDSs can be better understood by focusing on their depth and breadth: MDS depth is the level of penetration of MDSs among people; generally, it is measured by the

number of MDS users. MDS breadth refers to the variety of services and is measured by the number of different services available to mobile phone users.

Several researchers have categorised MDSs. For instance, Mort and Drennan (2005) identified six MDS types: location services (e.g., maps, directions and weather), communication services (e.g., multimedia messaging service (MMS) and short messaging service (SMS)), entertainment services (e.g., sports information, gambling and gaming), chat services (e.g., chatting and price enquiring while shopping), shopping services (e.g., coupons, personalised shopping alerts, movie tickets and bill payments), and financial services (e.g., banking services and online auctions).

Hong et al. (2008) classified MDSs into four categories: communication services (e.g., SMS, MMS, e-mails and mobile chatting), information content services (e.g., news, weather, sports, maps, location-based information and traffic information), entertainment services (e.g., ringtones, digital characters, horoscopes, gaming, television, video and music), and commercial transaction services (e.g., purchasing movie and concert tickets, and conducting financial transactions).

Nysveen et al. (2005) focused on four types of MDSs: text messaging, contact, payment and gaming services. They compared the interactivity and process

characteristics of the four MDS types, of which text messaging and contact services represented person–interactivity services, while payment and gaming services were characterised as machine–interactivity services. Both contact and gaming services were characterised as experiential services, while text messaging and payment services were characterised as goal-directed services.

Fang et al. (2006) categorised MDSs on the basis of task types and identified MDSs for transactional, gaming and general tasks. Their MDSs for transactional tasks related to financial transactions, while their MDSs for gaming tasks were for entertainment purposes and their MDSs for general tasks were for seeking information or for communicating with people.

2.2.2 *Effects of Demographics on the Digital Divide*

Prior research on the digital divide has taken a 'dichotomous' view, and has only distinguished between people who have or do not have access to technology (DiMaggio et al. 2004, Vicente Cuervo and López Menéndez 2006). However, basing the definition of the digital divide on ICT access gaps may be too narrow (DiMaggio et al. 2004, Warschauer 2004, Kauffman and Techatassanasoontorn 2005). This is because the digital divide is not a binary divide between technology haves and have-nots, but rather a graduated divide

based on different degrees of access to, and use of, information technology (Cisler 2000, Warschauer 2004).

Thus, DiMaggio et al. (2004) described the digital divide in five dimensions: technical means (hardware, software and connectivity), autonomy (location of access and freedom to use), use patterns (purposes of Internet use), skills (ability to use the Internet effectively) and social support networks (access to advice from more experienced users). Research on digital divide has used socio-demographic characteristics, such as gender, age, race, ethnicity, income and geography, to express differences amongst groups, and it has viewed the digital divide as a mirror of social inequality (Norris 2001, Warschauer 2004, Helbig et al. 2009).

Goldfarb and Prince (2008) studied determinants of the Internet divide in general, while other studies focused on determinants in specific contexts (Ratchford et al. 2003, Lorence et al. 2006). Helbig et al. (2009) studied the relationship of the e-government divide with gender, race and culture. Some studies have searched for information on topics such as new cars and health care (Bannerji and Kang 2005, Buente and Robbin 2008, Goldfarb and Prince 2008). Talukdar and Gauri (2011) found evidence of the existence of a significant digital divide among various socio-economic segments in terms of

Internet access and usage. They suggest that a high digital divide along socio-economic fault lines does not only exist, but it has widened in recent years. Other researchers have also found distinct Internet usage patterns among different socio-economic groups (Bannerji and Kang 2005, Lorence et al. 2006, Buente and Robbin 2008). Gefen and Straub (1997) and Venkatesh and Morris (2000) found a gender divide in perceptions for using IS.

2.2.2.1 Gender and the Digital Divide

Prior studies have reported gender differences in the use of technology (Cooper 2006, Bae and Lee 2010, Kim 2010), and there is a growing body of research investigating gender differences in technology usage (Wilson 2004, Shen et al. 2010). Gender has been studied as an independent variable or moderator variable in IS research (Shen et al. 2010).

Researchers have found that men and women have different attitudes towards technology in general (Lee and Lee 2010), and a distinctive nature in using technology (Venkatesh and Morris 2000). They also have differences in terms of their perceptions of ICT innovation characteristics (Gefen and Straub 1997, Van Slyke et al. 2002). Men are believed to be more task-oriented than women (Venkatesh and Morris 2000), they are more likely to engage in instrumental behaviour than women, and their attitude towards ICT use is more salient than

women (Venkatesh and Morris 2000, Venkatesh et al. 2004, Morris et al. 2005). Conversely, women are more communal (i.e., friendly and relationship-oriented), and are more likely to conform to majority opinion than men (Venkatesh et al. 2000, Zhang et al. 2009).

In the context of the Internet, men and women use it differently (Teo 2001), and their varying influence patterns suggest that gender has a moderating effect (Ilie et al. 2005, Shen et al. 2010). The Internet provides a range of different opportunities for personal engagement (Helsper 2010). Prior research suggests that men and women differ in their engagement with online content and platforms. Communication services are considered typically feminine, while entertainment services are typically masculine (Weiser 2000, Helsper 2010). However, the distinct attributes of communication and entertainment services can be unclear, as Internet-based communication services can also be entertaining and entertainment services can also involve communication (Helsper 2010). For example, chat rooms can be used for both communication and entertainment. However, in terms of the primary function, different services offer distinct benefits (e.g., games are primarily for entertainment and e-mails are primarily for communication) (Helsper 2010). Similarly, different Internet content can be classified according to their primary function, despite the fact that users may use content in a variety of ways and for a variety of

purposes (Helsper 2010). There is evidence that some Internet content, such as sexual, gaming and entertainment services, are dominated by men, with low rates of female participation (Weiser 2000). In contrast, prior research indicates a narrow range of services, such as health information services, are dominated by women (Warner and Procaccino 2007).

An online activity that is less clearly gender-based is Internet shopping (Helsper 2010). Although women tend to engage in offline shopping more than men, the opposite pattern is found for online shopping, with men being more active shoppers than women (Helsper 2010). However, this may be because online shopping definitions often include both 'window shopping' on price comparison websites and actual purchases (Helsper 2010). Nonetheless, there is some evidence to the contrary, particularly among young shoppers. For example, Gross (2004) found that teenage girls shop online more often than boys. The general male dominance of online shopping might be because technology has traditionally been a male domain, and online shopping is tightly intertwined with technology (Dholakia and Chiang 2003). Online male shoppers are more convenience-oriented and less motivated by social interaction than online female shoppers (Swaminathan et al. 1999). Thus, online functional consumption tends to be masculine, while experiential consumption tends to be feminine (Dittmar et al. 2004).

At the global level, despite cultural differences and gender stereotypes, there are differences in the patterns of ICT use by men and women (Dholakia 2006, Li and Kirkup 2007). There is a greater number of male than female Internet users (Dholakia 2006) and, although the physical access gap to the Internet between men and women is closing in the majority of high-income countries, gender difference is becoming more pronounced for Internet usage (Van Dijk 2006). Nevertheless, researchers report that the number of female Internet users at home tends to be higher in richer countries (Dholakia 2006). For instance, in Europe, Sweden has a higher percentage of female Internet users than lower-income countries such as Italy and, in Asia, Japan has a higher percentage of female Internet users than Singapore (Dholakia 2006). South Korea is an exception, with high levels of Internet use among both men and women compared to the levels in other countries that have higher incomes (Dholakia 2006). In contrast, the US data indicated that there are more women (55.1%) than men (44.9%) among those who only access the Internet from home, while there are more men (61.4%) than women (38.5%) who access the Internet from both home and work (Dholakia 2006). However, men spend more time online at home and marginally more time when they access the Internet from both work and home (Dholakia 2006). This is consistent with other reports that men spend more time on the Internet than women (Liff and Shepherd 2004, Li and Kirkup 2007).

Differences have also been reported in attitudes towards Internet searching and usage patterns between men and women (Li and Kirkup 2007). Prior research on gender differences relating to computers and the Internet suggests that, despite having generally positive attitudes towards computers, women have more negative attitudes towards technology than men, and more computer anxiety than men (Schumacher and Morahan-Martin 2001, Broos 2005). There is also evidence to suggest that women's use of, and liking for, computers and the Internet is less than that of men (Li and Kirkup 2007). Even when given equal access to computers and the Internet, women use them less than men (Schumacher and Morahan-Martin 2001). Research among young adults showed ICT, as an activity, to be male-stereotyped (Li and Kirkup 2007). Researchers have suggested that women are more likely to be disoriented by, and disenchanted with, the Internet than men, and they are less likely to browse compared to their male counterparts, unless necessary (Ford and Miller 1996). Women have more difficulty with, and are less confident in, finding information on the Internet than men (Li and Kirkup 2007). However, recent studies suggest that this is changing (Akman and Mishra 2010).

There is no shortage of opportunities to leverage MDSs for businesses and consumers (Lee and Lee 2010). However, the challenges of attracting consumers to try these services are substantial (Anckar and D'Incau 2002).

Research on gender differences in MDSs is relatively scarce, and very little of the work on genders and Internet usage has been extended to MDS context. Gendering MDS usage is an important issue because, despite nearly full penetration of mobile phones among people in the developed world, they may not be well-served by MDSs due to a lack of understanding of gender differences. In other words, if gender differences exist in MDS usage patterns, the benefits of MDSs may be disparate between genders. Nonetheless, there is an increasing number of women going online, and the gender gap in the Internet usage is narrowing (Li and Kirkup 2007, Akman and Mishra 2010). However, in my view, even after the gap narrows down, the actual behaviour in the use of different MDSs will continue to be differentially gendered.

2.2.2.2 Age and the Digital Divide

Prior research suggests that there are differences in the use of computer and Internet applications among people of different age groups (Van Dijk and Hacker 2003, Lee and Lee 2010). Young adults aged 20–30 are the most frequent users of the Internet (Losh 2009), spending their online time chatting, e-mailing, meeting new people and playing games (Kohut et al. 2007). Midlife adults are more likely to do business online (Losh, 2009). All age groups, apart from the very old, appear to use e-mail (Losh 2009). As such, marked differences appear in different age groups, in respect of the use of games,

spreadsheets, databases, book-keeping, drawing tools, e-mail and the Internet (Van Dijk and Hacker 2003).

Older people have different needs and concerns in using computers and the Internet compared to their younger counterparts (Hawthorn 2000, Wagner et al. 2010). This is due to the natural physical and cognitive changes that come with aging (Hawthorn 2000). Hawthorn (2000) explores the possible implications of the physical and cognitive changes from aging for human–computer interaction (HCI) designers (Wagner et al. 2010). Physical changes associated with aging include weakening vision, hearing impairment and slowing psychomotor abilities. Thus, large fonts and icons, layouts that require imprecise mouse movements and sounds within certain frequency ranges on the computer and web interfaces will be more appropriate for older users. Cognitive changes occur with aging, including a reduced attention span, a decline in memory and changes in spatial abilities. Hence, it is necessary for computer and web interfaces to be easy to understand and learn, to have few distractions, and to have provision for memory cues. Herring et al. (1995) and Fang and Yen (2006) pointed out that older users are less proficient in Internet use, while younger people find it easier to navigate. Although midlife and older people acquire new skills more slowly, once those skills have been learned, younger and older people perform similarly (Losh 2009).

In general, older people use computers and the Internet to a lesser extent than younger people; however, the older segment is growing quickly (Hart et al. 2008). In Japan, for example, Internet usage among older age groups was up by more than 20% during 2003–2006 (Akman and Mishra 2010). Similarly, in the US, around 40% of the baby boomers (aged 50–64) use the Internet for information search on a given day (Fallows 2008). The baby boomers represent an ICT growth market (Losh 2009). There are other studies which have reported that older people are keen users of the Internet with evolving motivational reasons (Juznic et al. 2006, Ng 2008).

Researchers identified a number of common uses of computers and the Internet by older people (Wagner et al. 2010). Their most frequent uses are for communication (Wagner et al. 2010), social support (Thayer and Ray 2006), entertainment (White and Weatherall 2000) and information seeking (Opalinski 2001). Thayer and Ray (2006) found that older people value the Internet as a useful tool for communication. Communication services such as e-mail, instant messaging and online forums help them to stay in touch with family members and increase their contact with family and friends (Thayer and Ray 2006), particularly grandchildren (White and Weatherall 2000). Thayer and Ray (2006) reported that older people who use e-mail to communicate with a significant family member were more likely to say that they

communicated more frequently with that family member because of e-mail. Nearly 56% of older people who use the Internet say that it has improved their connections with family (Thayer and Ray 2006). Similarly, older people (32%) were second only to 18–29 year olds (49%) in saying that the Internet helped them to increase their contact with friends and family (Kennedy et al. 2008). Communication services on the Internet also help them to cope with grief (Opalinski 2001) and deal with geographic boundaries or limited mobility (Alexy 2000).

Another common use of the Internet by older people is for leisure and entertainment, which tends to be related to offline interests and hobbies such as genealogy (White and Weatherall 2000). They also frequently go online to seek information (Opalinski 2001), particularly in the areas of health, education and productivity, including mental stimulation (Rosenthal 2008, Wagner et al. 2010). They also use the Internet for reading general and political news, checking the weather and doing research for their jobs (Thayer and Ray 2006). They, however, tend not to take advantage of many of the advanced tools available online as their younger counterparts (Bucur et al. 1999).

Thayer and Ray (2006) reported a number of statistics and observations based on their US study: 84% of older people in their study stated that they first

gained access to the Internet for reasons unrelated to work, 48% said they were encouraged to do so by family members, and 45% said they first gained access for personal reasons. Very few older people who first gained access for personal reasons said that they were encouraged by friends. Conversely, younger people reported that friends had a greater influence than family members in deciding to go online.

Thayer and Ray (2006) also reported a number of other statistics and observations. They found that whilst over half (56%) of the population in the US uses the Internet, only 15% of senior citizens (aged over 65) have Internet access. Moreover, 81% of people who say they definitely will not go online are over 50 years of age. Of those aged over 65, 56% say they definitely will not go online, compared to just 6% who say they definitely plan to go online.

Prior research discusses the reasons for non-use and the barriers to Internet use by older people. Melenhorst et al. (2006) suggest that while it is widely accepted that costs deter older people from using new technologies, it is actually the lack of perceived benefits that act as a deterrent. Either the technology does not meet the needs of the user, or they do not sufficiently understand the technology to appreciate the benefits (Wagner et al. 2010).

IS research has traditionally considered that older people are generally resistant to new technology. The theory of technology adoption points to age as a factor that influences when and how an individual adopts new technologies. Studies on cyberphobia suggest that there is a significant effect of an individual's age on the adoption and use of technology, with older people exhibiting high phobic levels (Meso et al. 2005). Age affects people's attitudes and behaviour and, as people age, they show greater reluctance to adopt new technologies (Oumlil and Williams 2000), they become more cautious and they seek greater certainty in their decisions, thus increasing their commitment to their existing behavioural patterns (Akhter 2003). Consequently, older people tend to adopt new technologies more slowly than their younger counterparts (Meso et al. 2005). They also exhibit more negative perceptions towards new technologies than younger people (Morris et al. 2005). As such, the use of the Internet for traditional tasks, such as shopping and banking, requires a decrease in commitment to their existing patterns of behaviour and a changing attitude (Akhter 2003).

2.3 Hypotheses Development

Among the different categorisations of MDSs discussed earlier (see Section 2.2.1), Fang et al.'s (2006) is the simplest and is also widely used; hence, Study 1

adopts this categorisation. Following Fang et al. (2006), three categories of MDSs were used to develop my hypotheses: communication, entertainment and transactional services.

2.3.1 *Gender*

Prior research examined the use of technology on the basis of users' demographic characteristics and revealed gender-based differences (Anckar and D'Incau 2002, Bigne et al. 2005, Constantiou et al. 2006). Men and women have different attitudes towards technology in general (Lee and Lee 2010), and have distinctive natures of technology adoption (Venkatesh and Morris 2000). Women have been found, for example, to be less comfortable with the Internet and they are less likely to use it than men (Gefen and Straub 1997).

Unlike the effect of gender differences on Internet usage which has been the subject of considerable research, there is limited research on the effect of gender differences in MDS usage. Some researchers have suggested that women are more likely than men to be mobile phone users (Totten et al. 2005) and that women are, in general, more willing to use mobile services (Anckar and D'Incau 2002). However, Constantiou et al. (2006) found that, compared to women, men are more frequent users of mobile services. Taking into account the mixed results in the literature, I hypothesise that:

H1: Generally, MDSs are more likely to be used by men than by women.

Further, while previous research recognised gender differences in various uses of the Internet, few researchers have investigated gender differences in the types of MDSs used. Anecdotal evidence suggests that men and women exhibit significantly different inclinations to use technologies (Gefen and Straub 1997). Women are less comfortable with the Internet and are less likely to use it for communication purposes than men (Gefen and Straub 1997). Conversely, some researchers report that women are more likely than men to use the Internet to connect with others (Jackson 2008). Moreover, women are more relationship-oriented and are more likely to conform to majority opinion than men (Venkatesh et al. 2000, Zhang et al. 2009). Some researchers have also suggested that communication services are typically feminine (Helsper 2010). Hence, similar gender-based differences in the use of MDSs are anticipated and the following hypothesis is proposed:

H2: Mobile communication services are more likely to be used by women than by men.

There is also evidence to suggest that women like computer technologies less than men (Li and Kirkup 2007). Even when given equal access to computers, women use computers less than men (Schumacher and Morahan-Martin 2001).

Research among young adults showed that IT activities were male-stereotyped (Li and Kirkup 2007). Researchers have also suggested that women are more likely to report significantly greater levels of disorientation and disenchantment in relation to the Internet (Broos 2005). Moreover, evidence suggests that some entertainment-related Internet content, such as sexual, gaming and video services, are dominated by men, with low participation rates in women (Weiser 2000). Consequently, entertainment services are typically considered masculine (Helsper 2010). Therefore, I hypothesise that:

> *H3: Mobile entertainment services are more likely to be used by men than by women.*

Researchers have suggested that women have higher levels of computer anxiety than men (Schumacher and Morahan-Martin 2001, Broos 2005). In addition, women have more difficulty with, and are less confident in, finding information (Li and Kirkup 2007). While reporting differential purposes of using the Internet between genders, researchers suggested that men are more likely to use the Internet for transactional activities (Jackson 2008). The general male dominance of online economic or financial activities is largely attributable to saving or making money, and not to the more experiential type of consumption (Holt 1995, Helsper 2010). Consequently, online functional

consumption tends to be masculine, while experiential consumption tends to be feminine (Dittmar et al. 2004). Therefore, I hypothesise that:

> *H4: Mobile transactional services are more likely to be used by men than by women.*

2.3.2 AGE

Prior research suggests that younger people are more likely to be innovators and early adopters of technologies than their older counterparts (Rogers 1995). However, turning specifically to mobile technologies, studies have shown mixed results on the impact of demographic variables (Stump 2008). For example, Ahn (2001) found significant effects of age on current and intended mobile subscriptions among South Koreans. Ahn's (2001) research revealed that the intention to subscribe to mobile phones is higher among youths than older people. Similarly, in Rice and Katz's (2003) US study, they found that age is a predictor for mobile phone adoption. Conversely, Wareham et al. (2004) found that mobile technology adoption is not correlated with age, whereas Suoranta and Mattila (2004) suggested that potential users of MDSs are likely to be older. Taking into account these mixed results, I hypothesise that:

> *H5: MDSs are more likely to be used by young people than by old people.*

Prior research has suggested that there are differences in the use of computer and Internet applications among people of different age groups (Van Dijk and Hacker 2003, Lee and Lee 2010). Young people are frequent users of the Internet and spend their online time chatting, e-mailing and meeting new people (Kohut et al. 2007). Conversely, IS research has traditionally considered that older people are generally resistant to new technologies. While older people (age 50–64 years) do use the Internet for e-mail, reading political and general news, checking the weather and searching for information for their work and personal needs, they are generally not frequent users of the Internet when compared to their younger counterparts (Losh 2009). Consequently, I hypothesise that:

> *H6: Mobile communication services are more likely to be used by young people than by old people.*

Old people have different needs and concerns compared to young people, which results from the natural physical and cognitive changes that are associated with aging (Hawthorn 2000, Wagner et al. 2010). Physical changes include weakening vision, hearing impairment and slowing psychomotor coordination, and cognitive changes include a reduced attention span, a decline in memory and changes in spatial abilities (Hawthorn 2000). Herring et al. (1995) and Fang and Yen (2006) observed that old people are less proficient in

Internet usage, whereas young people find it easier. In addition, young people are frequent users of the Internet and spend a substantial amount of time online for entertainment purposes such as playing games (Losh 2009). Hence, I hypothesise that:

> *H7: Mobile entertainment services are more likely to be used by young people than by old people.*

Studies on cyberphobia suggest that there is a significant effect of an individual's age on the adoption and use of technology, with older people exhibiting higher phobic levels (Meso et al. 2005). Age affects people's attitudes and behaviour and, as people age, they show greater reluctance to adopt new technologies (Oumlil and Williams 2000), they become more cautious and they seek greater certainty in their decisions, thus increasing their commitment to their existing behavioural patterns (Akhter 2003). Consequently, older people tend to adopt new technologies more slowly (Meso et al. 2005), and they also exhibit more negative perceptions towards new technologies (Morris et al. 2005). As such, using the Internet for traditional tasks, such as making a purchase, requires reducing a commitment to existing patterns of behaviour and a changing attitude (Akhter 2003). Researchers also report that the lack of a perceived benefit deters old people from using new technologies (Melenhorst et al. 2006). Either the technology does not meet the needs of old people or

they do not understand the technology sufficiently to appreciate the benefits (Wagner et al. 2010). Hence, I hypothesise that:

> *H8: Mobile transactional services are more likely to be used by young people than by old people.*

2.4 METHODOLOGY

A large-scale survey was conducted to collect the data used to test the above hypotheses. The survey approach was chosen over other methodological alternatives as it allows data collection from mobile phone users and non-users in a natural setting and without any interference. The variables investigated include age, gender and MDS usage.

2.4.1 INSTRUMENT DEVELOPMENT

The DVs in my logistic regression analyses are measures of specific MDS usage. To measure respondents' MDS usage, I developed a number of dichotomous response items for each of the three categories of MDSs, which were adapted from literature (e.g., Orviska and Hudson 2009) for Study 1: mobile communication services (Hong et al. 2008), mobile entertainment services (Fang et al. 2006) and mobile transactional services (Fang et al. 2006).

For mobile communication services, the respondents were asked whether they had used MDSs to access news, e-mail and maps. For mobile entertainment services, the respondents were asked whether they had used MDSs for gaming, gambling, videos, radio, music, films, chatting and social networking. For mobile transactional services, the respondents were asked whether they had used MDSs for paying bills, shopping and banking. IVs in the study are age and gender. Age in years was measured as an ordinal variable with five response intervals: 18–24, 25–34, 35–44, 45–54 and 55–64.

Table 2.1 summarises the data definitions. To ensure the face and content validity of my measures, I reviewed the instrument with two IS academics who are experts in scale development. I conducted a pilot test of seven individuals who had experience in the use of MDSs (four students and three professionals), and who were actively using mobile services, in order to assess the readability, length and clarity of the instrument. It took the participants approximately 10 minutes to complete the questionnaire. Based on their feedback, I refined the instrument further, presented them with the modified questionnaire, and they confirmed that there were no unclear statements in the modified version.

Table 2.1: Data Definitions

MDS usage (Orviska and Hudson 2009)	Coded 1 if the respondent indicated they used the mobile phone to conduct the online activity; otherwise, coded 0. The activities included were: (i) send and receive e-mails (ii) obtain news/weather forecasts (iii) shopping (iv) gaming (v) pay bills (vi) gambling (vii) watch videos or video clips (e.g., YouTube) (viii) listen to radio (ix) download music (x) download films (xi) access social networking site (e.g., facebook or Myspace) (xii) access directions/maps (xiii) watch mobile television (xiv) chatting (xv) banking
Gender	Male = 1, female = 2
Age (years)	18–24, 25–34, 35–44, 45–54, 55–64

2.4.2 PARTICIPANTS

The survey was conducted online in the UK among adults aged over 18 years. The UK has one of the highest mobile penetration rates in the world, with 130

mobile phone subscriptions per 100 inhabitants (Harris et al. 2005). The UK is also one of the largest mobile markets in Europe, and has one of the highest usage rates for mobile text messaging services among developed countries (Eurostat 2010). I collected usable survey data from 2,000 mobile phone users and non-users. A large research company in the UK posted the survey online for two weeks in mid-2008. Of the 2,000 respondents, 1,023 (51.2%) were female and 34.8% were under 35 years of age (see Figure 2.1).

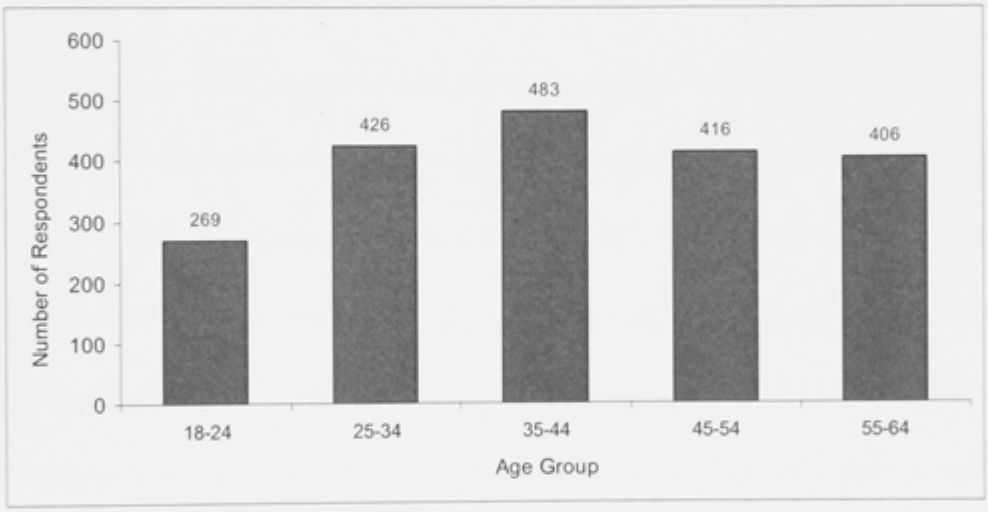


Figure 2.1: Distribution by age group

2.5 FINDINGS

In this study, I focused on three MDS categories in order to study the effects of gender and age on the digital divide: communication, entertainment and transactional services. I used logistic regression and chi-square (χ^2) tests to test eight hypotheses (see Section 2.3). Tables 2.2 to 2.5 present the results.

H1 concerns the effects of gender on the overall use of MDSs. I conducted 15 chi-square tests and 15 logistic regression analyses for 15 mobile services and gender. The χ^2 values ranged from 3.153 to 14.971, showing significant differences in the use of eight mobile services between men and women ($p < 0.01$) (see Table 2.3). Chi-square tests and logistic regression results showed that men generally use MDSs more than women ($p < 0.01$) (see Table 2.5). Thus, H1 is supported.

H2 focuses on mobile communication services. I tested the effects of gender on the use of e-mails, news and access to maps by conducting one chi-square test and one logistic regression analysis for each of the mobile communication services and gender. Contrary to H2, the proportions of men and women who used e-mails were 0.185 and 0.155, respectively ($\chi^2(1) = 3.153$, $p < 0.10$). However, the logistic regression result does not show that men used e-mails more than women ($p > 0.10$). In addition, contrary to H2, the proportions of men and women who read news were 0.162 and 0.137, respectively ($\chi^2(1) = 9.872$, $p < 0.01$). The logistic regression result also shows that men read news more than women ($p < 0.01$). Again, contrary to H2, the proportions of men and women who used directions and maps were 0.074 and 0.066, respectively, showing a statistically insignificant difference between men and women ($\chi^2(1) = 2.096$, $p > 0.10$). The logistic regression result also does not show any

difference between men and women using directions and maps ($p > 0.10$). Thus, H2 is not supported.

Table 2.2: Proportion of MDS Usage by Gender and Age

	E-mail	News	Shopping	Gaming	Pay bills	Gambling	Videos	Radio	Music	Films	Social networking	Access maps	m-TV	Chatting	Banking
Male	0.185	0.162	0.018	0.147	0.024	0.013	0.084	0.197	0.122	0.018	0.046	0.074	0.023	0.018	0.033
Female	0.155	0.137	0.023	0.132	0.020	0.010	0.063	0.143	0.107	0.011	0.044	0.066	0.020	0.017	0.018
Age (18–24)	0.260	0.216	0.041	0.216	0.041	0.026	0.141	0.264	0.167	0.019	0.126	0.112	0.033	0.033	0.052
Age (25–34)	0.223	0.218	0.035	0.263	0.038	0.019	0.115	0.293	0.197	0.028	0.087	0.124	0.035	0.033	0.038
Age (35–44)	0.186	0.153	0.021	0.143	0.01	0.006	0.046	0.172	0.106	0.004	0.025	0.056	0.025	0.010	0.027
Age (45–54)	0.137	0.079	0.010	0.055	0.017	0.005	0.034	0.096	0.063	0.005	0.012	0.038	0.005	0.010	0.014
Age (55–64)	0.069	0.039	0.005	0.005	0.002	0.000	0.005	0.047	0.020	0.002	0.005	0.012	0.002	0.002	0.002

Table 2.3: Use of MDSs by Men and Women

Type of Mobile Data Service	Male (%)	Female (%)	Chi-square	*p* value
E-mail	18.5	15.5	3.153	0.076
Obtain latest news/weather	16.20	13.70	9.872	0.002
Gaming	14.70	13.20	3.948	0.047
Watch videos (e.g., YouTube)	8.40	6.30	14.971	0.000
Listen to the radio	19.70	14.30	10.300	0.001
Download music	12.20	10.70	4.379	0.036
Download films	1.80	1.10	9.676	0.002
Banking	3.30	1.80	4.711	0.030

H3 considers mobile entertainment services. I tested the effects of gender on the use of mobile games, videos, radio and social networking by conducting one chi-square test and one logistic regression analysis for each of the mobile entertainment services and gender. The proportions of men and women who played mobile games were 0.147 and 0.132, respectively ($\chi^2(1) = 3.948$, $p < 0.05$). However, the logistic regression result does not show that men played mobile games more than women ($p > 0.10$). The proportions of men and women who watched videos were 0.084 and 0.063, respectively ($\chi^2(1) = 14.971$, $p < 0.01$). The logistic regression result also shows that men watched videos more than women ($p < 0.01$). The proportions of men and women who listened to the radio were 0.197 and 0.143, respectively ($\chi^2(1) = 10.30$, $p < 0.01$). The logistic regression result

also shows that men listened to the radio more than women ($p < 0.01$). The proportions of men and women who used social networking from their mobiles were 0.046 and 0.045, respectively ($\chi^2(1) = 0.05$, $p > 0.10$). Thus, all results, except for social networking, were significant and supported H3. Overall, H3 is supported.

Table 2.4: Use of MDSs by Age Groups

Type of Mobile Data Service	18–24 (%)	25–34 (%)	35–44 (%)	45–54 (%)	55–64 (%)	Chi-square	*p* value
E-mail	26.0	22.3	18.6	13.7	6.9	57.494	0.000
Obtain latest news/weather	21.6	21.8	15.3	7.9	3.9	83.364	0.000
Shopping	4.1	3.5	2.1	1.0	0.5	17.089	0.002
Gaming	21.6	26.3	14.3	5.5	0.5	159.215	0.000
Pay bills	4.1	3.8	1.0	1.7	0.2	21.570	0.000
Gambling	2.6	1.9	0.6	0.5	0.0	16.226	0.003
Watch videos (e.g., YouTube)	14.1	11.5	4.6	3.4	0.5	79.783	0.000
Listen to the radio	26.4	29.3	17.2	9.6	4.7	123.146	0.000
Download music	16.7	19.7	10.6	6.3	2.0	87.503	0.000
Download films	1.9	2.8	0.4	0.5	0.2	19.241	0.001
Access a social networking site (e.g., facebook or Myspace)	12.6	8.7	2.5	1.2	0.5	89.101	0.000
Access maps/directions	11.2	12.4	5.6	3.8	1.2	57.922	0.000
m-TV	3.3	3.5	2.5	0.5	0.2	19.822	0.001
Chatting	3.3	3.3	1.0	1.0	0.2	19.066	0.001
Banking	5.2	3.8	2.7	1.4	0.2	21.270	0.000

Table 2.5: Results of Logistic Regression Analysis

	E-mail	News	Shopping	Gaming	Pay bills	Gambling	Videos	Radio	Music	Films	Social networking	Access maps	m-TV	Chatting	Banking
Gender	–0.144	–0.328***	0.370	–0.134	–0.239	–0.509	0.614***	–0.296***	–0.202	–1.447***	0.151	– 0.153	–0.189	–0.102	–0.526*
Age	–0.341***	–0.444***	–0.524***	–0.641***	–0.522***	–0.718***	–0.643***	–0.493***	–0.499***	–0.544***	–0.849***	–0.510***	–0.538***	–0.572***	–0.511***
R^2	0.029	0.042	0.009	0.070	0.009	0.008	0.043	0.058	0.039	0.010	0.041	0.026	0.009	0.008	0.012
Adjusted R^2	0.048	0.076	0.050	0.130	0.051	0.079	0.115	0.097	0.080	0.089	0.133	0.068	0.052	0.054	0.060

*p < 0.10, **p < 0.05, ***p < 0.01.

H4 concerns mobile transactional services. I tested the effects of gender on shopping, paying bills and banking by conducting one chi-square test and one logistic regression analysis for each of the mobile transactional services and gender. The proportions of men and women who participated in shopping were 0.018 and 0.023, respectively ($\chi^2(1) = 0.617$, $p > 0.10$). The logistic regression result also does not show that women shopped more than men ($p > 0.10$). Both test results show that the differences in shopping behaviour are statistically insignificant between men and women. The proportions of men and women who used bill payment services were 0.024 and 0.017, respectively ($\chi^2(1) = 1.222$, $p > 0.10$). The logistic regression result also does not show that men used bill payment services more than women ($p > 0.10$). The proportions of men and women who used mobile banking services were 0.033 and 0.018, respectively ($\chi^2(1) = 4.711$, $p < 0.05$). The logistic regression result shows that men used mobile banking services more than women ($p < 0.05$). Thus, H4 is not supported.

H5 considers the effect of age on the overall use of MDSs. I conducted 15 chi-square tests and 15 logistic regression analyses for the 15 mobile services by age group. The χ^2 values ranged from 16.226 to 159.215 ($p < 0.01$). Table 2.4 shows that younger people engage in all MDS categories at higher rates than their older counterparts. According to Table 2.5, all logistic regression results also

show that young people use MDSs more than old people ($p < 0.01$). Thus, H5 is supported.

H6 focuses on mobile communication services. I tested the effects of age on the use of e-mails, news and access to maps by conducting one chi-square test and one logistic regression analysis for each of the mobile communication services and age. The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who used e-mails were 0.260, 0.223, 0.186, 0.137 and 0.069, respectively ($\chi^2(1) = 57.494$, $p < 0.01$). The logistic regression result also shows that young people used e-mails more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who read the news were 0.216, 0.218, 0.153, 0.079 and 0.039, respectively ($\chi^2(1) = 83.364$, $p < 0.01$). The logistic regression result also shows that young people read the news more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who accessed maps and direction service were 0.112, 0.124, 0.056, 0.038 and 0.012, respectively ($\chi^2(1) = 57.922$, $p < 0.01$). The logistic regression result also shows that young people accessed maps and direction services more than old people ($p < 0.01$). Thus, H6 is supported.

H7 concerns mobile entertainment services. I tested the effects of age on the use of games, videos, radio and social networking by conducting one chi-square test and one logistic regression analysis for each of the mobile entertainment services and age. The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who played games were 0.216, 0.263, 0.143, 0.055 and 0.005, respectively ($\chi^2(1) = 159.215$, $p < 0.01$). The logistic regression result also shows that young people played games more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who watched videos were 0.141, 0.115, 0.046, 0.034 and 0.005, respectively ($\chi^2(1) = 79.783$, $p < 0.01$). The logistic regression result also shows that young people watched videos more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who listened to the radio were 0.264, 0.293, 0.172, 0.096 and 0.047, respectively ($\chi^2(1) = 123.146$, $p < 0.01$). The logistic regression result also shows that young people listened to the radio more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who accessed social media from their mobile were 0.126, 0.087, 0.025, 0.012 and 0.005, respectively ($\chi^2(1) = 89.101$, $p < 0.01$). The logistic regression result also shows that young people accessed social media more than old people ($p < 0.01$). Thus, H7 is supported.

Finally, H8 considered mobile transactional services. I examined the effects of age on the use of shopping, paying bills and banking by conducting one chi-square test and one logistic regression analysis for each of the mobile transactional services and age. The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who participated in shopping were 0.041, 0.035, 0.021, 0.010 and 0.005, respectively ($\chi^2(1) = 17.089$, $p < 0.01$). The logistic regression result also shows that young people participated in shopping more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who paid bills from a mobile device were 0.041, 0.038, 0.01, 0.017 and 0.002, respectively ($\chi^2(1) = 21.570$, $p < 0.01$). The logistic regression result also shows that young people paid bills from a mobile more than old people ($p < 0.01$). The proportions of people from the 18–24, 25–34, 35–44, 45–54 and 55–64 age groups who used mobile banking were 0.052, 0.038, 0.027, 0.014 and 0.002, respectively ($\chi^2(1) = 21.270$, $p < 0.01$). The logistic regression result also shows that young people used mobile banking more than old people ($p < 0.01$). Thus, H8 is supported.

2.6 Discussion

In this section, I discuss my key findings followed by a discussion of the research and practical contributions of those findings.

2.6.1 *Key Findings*

The major findings of Study 1 are summarised in Table 2.6. First, the study finds limited use of various MDSs in both genders and all age groups (see Table 2.2 and Table 2.5). Limited MDS usage indicates that the majority of users have not yet realised the benefits of MDSs. Instead, they might perceive that the Internet can provide better services. It also implies that there may not be sufficiently useful MDSs for potential users who are in need of those services. Limited usage among older groups also implies that older people feel more alienated by MDSs. This may explain the fact that most service carriers and content providers are eager to develop so-called 'killer applications' only for young users, who reportedly spend more money on mobile services, thereby decreasing opportunities for older users.

Second, the study shows that there are gender-based differences in the usage of MDSs among individuals. Significant differences between genders were found in a few MDSs such as e-mails, news, gaming, videos, radio, music, maps and banking, with men tending to use these services more than women. MDS usage for social networking and chatting was not significantly different between men and women. Although women tended to use mobile shopping services more than men, the difference was not statistically significant. Thus, MDS usage is greater among men than women.

Table 2.6: Summary of Findings

Hypotheses	*p* value
H1: Generally, MDSs are more likely to be used by men than by women.	< 0.01
H2: Mobile communication services are more likely to be used by women than by men.	> 0.10
H3: Mobile entertainment services are more likely to be used by men than by women.	< 0.01
H4: Mobile transactional services are more likely to be used by men than by women.	> 0.10
H5: MDSs are more likely to be used by young people than by old people.	< 0.01
H6: Mobile communication services are more likely to be used by young people than by old people.	< 0.01
H7: Mobile entertainment services are more likely to be used by young people than by old people.	< 0.01
H8: Mobile transactional services are more likely to be used by young people than by old people.	< 0.01

Third, the study finds that age negatively affects MDS usage, as older people were less likely to have used MDSs. Usage first increased and then declined with age, with the turning age being 25 for news, maps, gaming, music and videos. Users of all age groups used communication services, such as e-mail which was most widely used. Users in their 20s and early 30s showed relatively higher usage in all service categories compared to older users. Thus, the

findings suggest that different MDSs have different implications for different age groups.

2.6.2 *Theoretical Contributions*

Prior research has investigated the roles of gender and age in the use of technology. In particular, a number of studies have assessed the roles of gender and age in the use of the Internet, and some of those studies have suggested gender and age differences in the use of different Internet contents.

Although gender and age have been widely studied, few researchers have investigated them in the context of different MDS usage. My research aim was to fill this gap by studying the roles of gender and age divides in MDS usage and, as anticipated, I have found these differences in the use of various MDSs.

In support of past reports that found that men use Internet-based services more than women, the results of my study reveal that the majority of MDS users are male. However, some services are gender-neutral and some services are female-dominated. It is likely that the users are still uncertain about many of the services and/or the soundness of the underlying technology platform. As MDSs mature, the users will acquire more knowledge about the services and the soundness of their underlying technology platforms, allowing them to form

opinions that are more positive. As a result, the usage of MDSs will rise across all gender and age groups.

2.6.3 *Practical Implications*

The findings of the study are important for both mobile service providers, who are eager to create continuous sources of revenue, and to computing professionals. The study provides the MDS industry with a clear view of mobile users based on gender and age. The services most and least used were similar between men and women; however, men showed a higher use of MDSs. In particular, men used entertainment services more than women. The study will help companies develop more consistent revenue streams from users who are willing to spend more if useful and informative content is available. Moreover, applications should be made more attractive to women and the older population. Producers, designers and policymakers need to address design, culture, language and identity issues while designing and delivering mobile applications and services (Van Dijk and Hacker 2003).

The study is also relevant to service providers' strategic goals of expanding new channels across different market segments. As the use of mobile channels increases, not only as alternative advertisement channels to reach target markets, but also as alternative transaction channels to sell services, the

findings offer strategic insights to make such target-based marketing more effective. The study has identified early adopters' profiles in terms of their basic demographic characteristics (gender and age); such information is useful to those designing effective strategies for their target market. The results may also be used to identify consumer niches that might be interested in specific MDS offerings. In particular, the results are useful to those targeting specific demographic markets for MDSs.

The findings of the study are also of considerable importance to researchers who examine the impact of MDSs on society, and to policymakers who are interested in understanding the challenges posed by the digital divide to the societal diffusion of one of the most heralded ICT innovations, MDSs. Such understanding is imperative from the perspective of both economic efficiency and social equity. The economic efficiency relevance of understanding the challenges posed by the digital divide is apparent from the ever-expanding operational role of mobile technologies in the marketplace. The social equity relevance stems from the increasingly important societal goal of achieving an effective and equitable cyber society, where mobile technologies can serve as conduits for the provision of a myriad of services, as well as serving as a tool to stimulate a more engaged and participatory civic community.

The study underscores significant opportunities that exist for mobile businesses in more effectively reaching and serving the market at the bottom of the economic pyramid, as relevant public policy initiatives increasingly aim to break down the digital divide via the spread of MDSs. Regarding the public policy goal of achieving an effective and equitable cyber society (Jensen et al. 2007), this study offers insights into the presence of digital divides across important segments of society. These insights are naturally of significant importance when prioritising relevant policy targets and initiatives. The findings highlight the issue of gender-based and age-based digital divides as key areas for the evaluation of past policy initiatives and for the prioritisation of future initiatives.

2.6.4 LIMITATIONS

The study is not without limitations. First, it only investigated two socio-demographic variables: age and gender. Further research on the digital divide should examine the effects of other variables on the use of MDSs, such as income, social class, job nature and education. Second, as the study examined data collected in the UK, which is a developed country, the findings may be generalised to other developed countries. Future research should be directed towards determining the validity of the findings in other countries, and in

particular, the developing countries, which can have differences in terms of both MDS market status and cultural origins.

2.7 Summary of Study 1

The term 'digital divide' refers to differences in the amount and patterns of technology usage due to the gap between people who have the access and skills to use ICTs and those who do not. While widespread access to, and use of, mobile ICTs would result in higher standards of living and improved social welfare, the digital divide is a concern, as it reinforces inequalities in opportunities for economic and social development.

Study 1 examined the digital divide in MDS usage from a socio-demographic perspective. It examined the effects of gender and age on MDS usage on the basis of data collected in an online survey in the UK from 2,000 mobile phone users and non-users on both sides of the divide (i.e., with or without access to mobile ICTs). Logistic regression and nonparametric chi-square tests were used to test the hypotheses on the effects of gender and age on MDS usage. My findings demonstrate that men are more likely than women to use MDSs and that young people are more likely than their older counterparts to use MDSs.

The study contributes to the literature on MDSs by highlighting the effects of the digital divide. The findings provide insights to MDS providers on how to develop and promote their services for different socio-demographic groups, and to policymakers on how to recognise groups who underutilise MDSs.

Chapter 3

A Literature Review of Mobile Banking: Concepts and Potential

3.1 Background of Mobile Banking

The increasing pervasiveness of mobile technologies such as mobile phones, PDAs and iPhones is advantageous to the adoption of MDSs. Of the various MDSs, m-banking has the most potential for economic and social benefits (Economist 2007, Kim et al. 2009). M-banking refers to technology-mediated banking services provided via mobile telecommunication devices such as mobile phones and PDAs (Mallat et al. 2004).

M-banking is a new channel that can support and enhance existing banking services. It is a more flexible and ubiquitous way for banks to communicate with their customers (Barnes and Corbitt 2003), and it complements and sometimes competes with existing channels (Morrison and Roberts 1998, Meuter et al. 2000). It facilitates 'anytime and anywhere' banking, unlike traditional branches which deliver services through face-to-face interactions.

Typical m-banking functions include viewing account balances, transferring funds from one account to another, receiving alerts and paying bills. However, m-banking cannot support all banking functions. For instance, cash can only be withdrawn at physical branches or at ATMs. Special functions, such as opening a bank account, may require face-to-face meetings between customers and bank staff. Thus, m-banking cannot fully replace physical branches or ATMs.

Both practitioners and researchers are interested in m-banking. Practitioners are generally interested in how to leverage m-banking to enhance banking services. In today's competitive market, banks are keen to shift their customers to m-banking in order to cut costs (Constantiou et al. 2007). Banks aspire to be low-cost leaders and differentiators at the same time, and m-banking allows banks to increase personal services without raising costs (Tallon 2010). In addition to reducing costs to the banks, providing banking services via the mobile channel generates additional revenue for telecommunication service providers (Kim et al. 2009, GSMA 2010b). Researchers are also interested in the reasons as to why bank customers adopt m-banking (Yang 2009), but little work has been done on other m-banking issues, despite calls from senior scholars for more research in this area (Venkatesh 2006, Curran and Meuter 2007, Nickerson 2008). To the best of my knowledge, no review of m-banking exists. Thus, this review article aims to answer the following question:

> *What do we know and not know about m-banking, particularly behavioural issues?*

This review article, which forms Part I of Study 2, contributes to the m-banking literature in two ways. First, as users have experienced a decade of the m-banking phenomenon, it is timely to reflect on how academics perceive m-banking. This review has surveyed and synthesised articles in the area of m-

banking published between January 2000 and June 2010. It has helped to identify trends and patterns and reveal our progress as a research community. Second, the research on m-banking so far seems fragmented; it lacks a roadmap and an agenda. This review not only leads to a better understanding of the current state of m-banking, but also identifies areas where more work needs to be done and proposes a number of research questions. Synthesising existing findings also reveals important research gaps and helps researchers avoid duplication.

The remainder of this chapter is organised as follows. Section 3.2 describes the methodology used in the study. Section 3.3 presents the criteria used for classifying the m-banking literature. The results of the analysis follow in Section 3.4 and Section 3.5 presents a discussion. Section 3.6 presents limitations and Section 3.7 presents a summary of the study.

3.2 Research Methodology

I conducted an extensive literature review to determine the state-of-the-art and future directions in m-banking research. Given that m-banking is an interdisciplinary topic, I included academic journals from various disciplines such as IS, technology innovation, management and marketing. The literature

search also included IS conference proceedings in recognition that m-banking is an emerging academic area.

I conducted a literature search based on the descriptors 'mobile banking' and 'm-banking'. Table 3.1 lists the online databases and conferences that I searched.

In terms of journals, I reviewed six top-tier IS journals: European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of the Association for Information Systems, Journal of Management Information Systems (MIS) and MIS Quarterly. I also included other well-recognised IS journals: Association for Computing Machinery (ACM) Transactions on Computer-Human Interaction, ACM Transactions on Information Systems, Communications of the Association for Information Systems, Decision Support Systems, Electronic Commerce Research, Information and Management, International Journal of Electronic Commerce, Information Technology and People, Journal of Behavioural Decision Making, Journal of Information Systems, Journal of Information Technology and Scandinavian Journal of Information Systems.

In addition to journal articles, I considered six major peer-reviewed IS conferences and one major mobile business conference. These conferences

represent the cutting edge of research and often provide a preview of future top-ranked publications.

Table 3.1: Selected Online Databases and Conferences for the M-banking Literature Search

Online databases	• ABI/INFORM database • ACM Digital Library • AIS eLibrary • Google Scholar • IEEE Xplore • ScienceDirect • Web of Science • Wiley InterScience
Conferences	• Americas Conference on Information Systems (AMCIS) • Australasian Conference on Information Systems (ACIS) • European Conference on Information Systems (ECIS) • Hawaii International Conference on System Sciences (HICSS) • International Conference on Information Systems (ICIS) • International Conference on Mobile Business (ICMB) • Pacific Asia Conference on Information Systems (PACIS)

I reviewed the full text of each article to eliminate those that were not actually related to m-banking. I conducted backwards and forwards searches for more articles using the reference lists of the articles identified as 'intensely m-banking'. I excluded articles where m-banking was only a minor section of a study on mobile commerce (m-commerce) or mobile payments. I only considered research papers published between January 2000 and June 2010,

because m-banking research is relatively new and it is important to be current in the field.

3.3 Classification Method

I adopted the classification framework for m-banking research from the framework by Ngai and Gunasekaran (2007). Their framework is based on the work of Mennecke and Strader (2003), Varshney and Vetter (2002) and Mathew et al. (2004). Varshney and Vetter (2002) identified that m-commerce applications require the technological support of wireless user infrastructure, mobile middleware and wireless network infrastructure. Ngai and Gunasekaran (2007) enhanced their framework by adding theory-based research activities and behavioural, strategic and legal considerations. Their framework comprised categories such as: (1) overview and conceptualisation, (2) applications and cases, (3) behaviour, (4) infrastructures, and (5) strategic, legal and ethical issues in m-commerce. This framework has been applied in studies by Büyüközkan (2009) and Dai and Palvi (2009). I have used Ngai and Gunasekaran's (2007) framework to review m-banking literature and I have assigned them to five categories based on the core topic of each article.

Category 1 (m-banking overview and conceptualisation) covers articles that deal with general introductions (i.e., m-banking overview) and foundational

concepts (i.e., conceptual framework). It also includes research on the m-banking market. For example, Mallat et al. (2004) reviewed emerging m-banking applications and main players in the mobile financing value chain, such as banks and telecommunication service providers. Riivari (2005) examined the European mobile market and how financial organisations take advantage of m-banking to improve customer services and relationships. He suggested that, in the coming decade, banks would begin pushing 'anytime and anywhere' banking; thus, the future for the m-banking market is 'not only bright, it is also very big' (p. 19). Xiangpei et al. (2008) proposed a set of selection criteria for identifying and evaluating m-commerce killer applications, and suggested that the coming years will be the decade of m-banking applications. Jarvenpaa and Lang (2005) identified eight mobile technology paradoxes (e.g., empowerment versus enslavement, and independence versus dependence) that shape user experience and behaviour. They suggested possible design features that relate to these paradoxes and discussed how these features could be better managed.

Category 2 (m-banking applications and cases) covers a range of m-banking applications such as SMS banking, stock trading services, mobile money transfer services and information services. It also includes case studies of companies, industries and countries. The articles in this category are organised

into two broad sub-categories: planning for IS applications and mobile services for financial markets. An example of the first sub-category is the study by Peffers and Tuunanen (2005) who used information theory to justify a method for managers to better understand the new IT applications and features that would be most valued by the users and the reasons thereof, and then applied the method in a case study of an m-banking application development. The design by Muntermann (2009) of a mobile financial notification decision support system to assist individual investors to access capital market information promptly and avoid missing significant trading opportunities is an example of the second sub-category.

Category 3 (m-banking behaviour) contains articles that examine the perceptions, decisions, and technology acceptance and use of m-banking applications. The perspectives of both users and service providers are covered. Articles in this category investigate intention, adoption, decision-making, channel comparison, consumer profiling, innovation resistance, and trust and satisfaction. For example, Kim et al. (2009) studied the effect of trust-inducing forces, such as structural assurances, relative benefits, personal propensity to trust and firm reputation, on shaping a person's initial trust in their intention to use m-banking. Yang (2009) investigated the factors associated with adopting and resisting m-banking. Zhou et al. (2010) studied the effect of task–

technology fit on users' m-banking adoption. Karjaluoto (2002) studied consumers' selection criteria for how they paid bills. Laukkanen (2007b) compared customers' value perceptions in Internet and mobile banking. Laukkanen and Pasanen (2008a) studied how m-banking innovators and early adopters differ from other online users. Laukkanen et al. (2007) investigated and compared mature consumers and younger consumers as to their reasons for resisting m-banking. Chung and Kwon (2009) studied the moderating effect of trust on customer satisfaction and perceptions of system quality, information quality and information presentation.

Category 4 (m-banking infrastructures) includes articles that discuss wireless user infrastructure, mobile middleware and wireless network infrastructure. Wireless user infrastructure includes articles on mobile software interfaces, browsers, mobile hardware interfaces or devices (e.g., mobile phone interfaces), PDAs and iPhones. Mobile middleware refers to articles that discuss database management, wireless and mobile protocols, agent technologies and security issues, with security issues being the predominant topic of discussion in this subcategory. Wireless network infrastructure includes wireless networks and network standards such as global systems for mobile communication (GSM), Bluetooth, wireless local area network (WLAN), radio frequency identification (RFID) and third generation (3G) networks (Ngai and Gunasekaran 2007).

Category 5 (m-banking strategic, legal and ethical issues) covers a range of articles on privacy, regulation and the legal environment. This category also includes articles on m-banking economics, strategy and business models. Stamoulis (2000) proposed a post-implementation contingency model that examined the problems of using five perspectives to evaluate the business value of electronic banking delivery channels. The five perspectives are customer, marketing, financial, information technology and strategic. For each perspective, the researcher proposed specific measurements and criteria for success that pertained to the electronic banking channel. Stamoulis's (2000) framework could be used as a point of research departure to evaluate new m-banking investments. Oh and Lee (2005) examined how mobile carriers, banks and other related parties form alliances. They analysed how technology affects competition and collaboration when a convergence service is created by two previously unrelated industries; namely, banks and telecommunication service providers.

Figure 3.1 depicts the classification framework used in this chapter for Study 2 (Part I). Table 3.2 summarises the articles in each of the five categories.

Figure 3.1: Classification of topics on m-banking

Table 3.2: Classification of the Reviewed M-banking Literature

Classification criteria	References
M-banking Overview and Conceptualisation	
M-banking overview	Barnes and Corbitt (2003), Herzberg (2003), Mallat et al. (2004), Xiangpei et al. (2008)
Mobile market	Pousttchi and Schurig (2004), Borreguero and Pelaez (2005), Riivari (2005)
Conceptual framework	Chen et al. (2001), Kemper and Wolf (2002), Jarvenpaa and Lang (2005), Kousaridas et al.(2008)
M-banking Applications and Cases	
Applications planning	Al-Taitoon and Sorensen (2004), Peffers and Tuunanen (2005)
Financial applications	Muntermann and Guettler (2004), Muntermann and Janssen (2005a), Muntermann (2009)
M-banking Behaviour	
Intention	Anckar and D'Incau (2002), Kleijnen et al. (2004), Suoranta and Mattila (2004), Tang et al. (2004), Luarn and Lin (2005), Wang et al. (2006), Amin et al. (2008), Hoehle and Huff (2009), Joubert and Van Belle (2009), Kim et al. (2009), Lou et al. (2010)
Adoption	Brown et al. (2003), Lee et al. (2003), Crabbe et al. (2009), Yang (2009), Zhou et al. (2010)
Decision-making	Karjaluoto (2002), Brown et al. (2005), Chang (2008), Dewan et al. (2009)
Channel comparison	Laforet and Li (2005), Laukkanen and Lauronen (2005), Laukkanen (2007a), Laukkanen (2007b), Laukkanen (2007c)
Consumer profiling	Laukkanen and Pasanen (2008a)
Innovation resistance	Laukkanen et al. (2007), Lee et al. (2007),

Classification criteria	References
	Laukkanen et al. (2008b)
Trust and satisfaction	Chu and Yao-bin (2009), Chung and Kwon (2009), Lee and Chung (2009a), Wati et al. (2009)
M-banking Infrastructures	Claessens et al. (2002), Muntermann et al. (2005b), Singh Ghotra et al. (2007), Ngo et al. (2008)
M-banking Strategic, Legal and Ethical issues	
Strategy	Stamoulis (2000), Scornavacca Jr and Barnes (2004), Bonina and Illa (2008)
Convergence	Oh and Lee (2005)
Legal and ethical issues	Anderson (2010), Weber and Darbellay (2010)

In addition to classifying articles by (1) research topic, I also analysed and distributed the articles on the basis of (2) research methods, (3) data analysis methods, (4) theories used, (5) countries where data were collected, (6) year of publication, and (7) journal and conference. The findings of all these analyses are presented in Section 3.4.

3.4 Results of the Analysis

I reviewed and classified 65 articles according to the aforementioned categories, and the results are presented in this section. It is noteworthy that the total number of articles in any classification did not reach the total number of articles reviewed (i.e., 65 articles), because some articles were not relevant to any of the categories.

3.4.1 *Distribution of Articles by Research Topic*

Figure 3.2 shows that most articles (33 articles or 54% of the total) were related to category 3, m-banking behaviour, and as expected, intention and adoption issues made up a large proportion of reviewed articles under this category. The second most common topic was related to category 1, m-banking overview and conceptualisation (12 articles or 20% of the total). The domination of category 1 (overview and categorisation) and category 3 (behaviour) reflects that m-banking is a relatively young area of research. It is conceivable that many researchers may attempt to understand user acceptance and conceptual issues in the early stages of the m-banking adoption life cycle. Articles in category 2—m-banking applications and cases—made up 10% of the total (6 articles), and articles in category 5—strategic, legal and ethical issues—made up 10% of the total (6 articles) with articles in category 4, m-banking infrastructures, has the least number of articles (4 articles or 7% of the total). Table 3.3 summarises the findings.

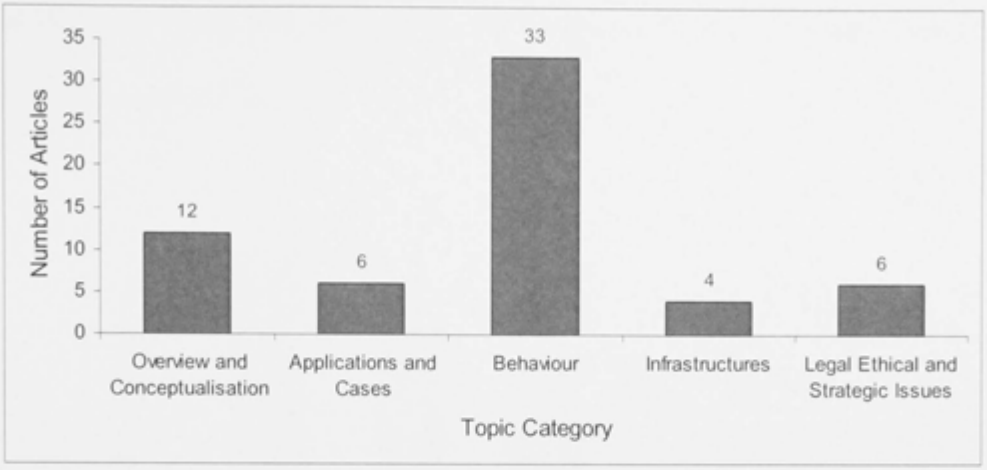


Figure 3.2: Distribution of articles by topic

3.4.2 Distribution of Articles by Research Method

The purpose of distributing the articles by the research and data analysis methods is to develop an understanding of the design and data analysis methods that are used for m-banking research. Figure 3.3 shows that most of the empirical research on m-banking has been done through surveys. Twice as many articles used survey data collection, compared to qualitative research methods. Archival research was used less often than qualitative research methods. Notably none of the reviewed articles collected data via experiments, and only a small proportion of articles used a design–science approach. The total number of conceptual articles (20 articles) in my review was more than two-thirds of the total number of survey-based studies (28 articles). Figure 3.3 indicates that a substantial number of conceptual articles exist in the m-

banking literature that do not use any empirical research methods; instead, they use analytical methods.

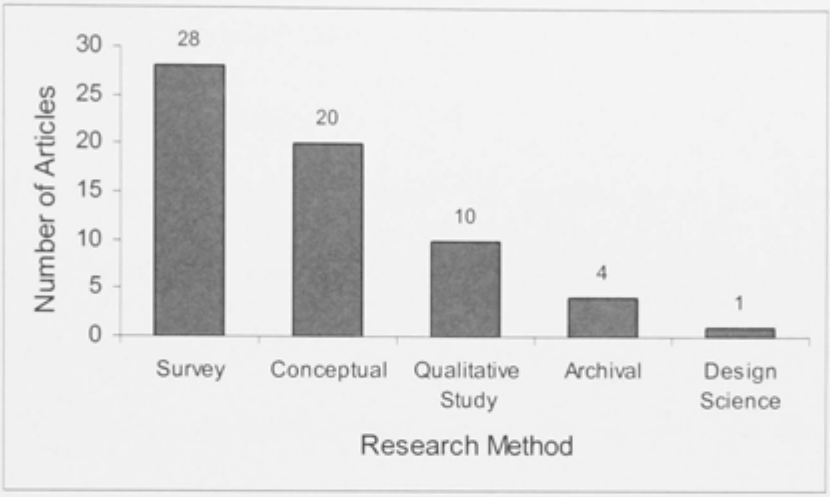


Figure 3.3: Distribution of articles by research method

3.4.3 Distribution of Articles by Data Analysis Method

The data analysis method used in empirical research is an important indication of the sophistication of the research design. As expected, structural equation modelling was the most widely used quantitative data analysis method, used in 16 reviewed articles, followed by descriptive statistics (5 articles), regression analysis (4 articles), t-tests (3 articles), and conjoint analysis (2 articles). (M)ANOVA, cluster, and Rasch and Zaltman Metaphor Elicitation Technique (ZMET) analysis were each used in one reviewed article.

3.4.4 *Distribution of Articles by Theory Used*

IS researchers often base their research on existing theories. The technology acceptance model was widely used (6 articles), which is not surprising, given the popularity of the model over the last decade. The IS success model (3 articles) and task-technology fit model (3 articles) were also reasonably common. Other models included the theory of planned behaviour (2 articles), the actor-network theory (2 articles), the Rasch model (1 article) and the unified theory of acceptance and use of technology (1 article). It is noteworthy that many empirical studies did not use a theory. Table 3.3 identifies the empirical studies by reference to the theories used in those studies.

Table 3.3: Empirical Studies Related to Mobile Banking

Authors[1]	Theoretical Foundation	Context and Method	Independent Variables	Dependent Variables	Results[2]
Brown et al. (2003)	Technology acceptance model (TAM)	Eleven semi-structured interviews with mobile phone and bank users in South Africa	Cost, resistance to change, exposure, relative advantage, ease of use, perceived risk	Adoption	Resistance to change, exposure, relative advantage, perceived ease of use, perceived risk and cost influence adoption decision.
Chang (2008)	TAM	Survey of 249 general mobile phone users in Australia	Perceived usefulness, perceived ease of use, perceived enjoyment, perceived risk, phone type service plan, demographics, PC ownership	Intention	Perceived enjoyment is more influential than usefulness and ease of use on intention to use mobile phones for personal information management. Perceived risk is salient for commercial transactions. Gender and PC ownership are important moderators.
Chu and Yao-bin (2009)	None	Online survey of 313 college students who used online banking in China	Personal factors (trust propensity), cognition-based factors (relative advantage, compatibility), institutional factors (structural assurance, firm	Initial trust of m-banking, usage intention	Online trust influences initial trust and perceived structural assurance. Previous satisfaction with online banking influences on initial trust, perceived relative advantage and perceived compatibility.

Authors[1]	Theoretical Foundation	Context and Method	Independent Variables	Dependent Variables	Results[2]
			reputation)		
Crabbe et al. (2009)	TAM	Survey of 271 bank users in Ghana	Usefulness, ease of use, perceived elitisation, credibility, facilitating conditions, sustained usefulness, demographics	Attitude, intention, usage, sustained usage	Elitisation positively influences adopters' and negatively influences non-adopters' attitude. Perceived credibility and facilitating conditions influence attitude. Demographics, social and cultural features influence adoption.
Hoehle and Huff (2009)	Task-technology fit model (TTF)	Nine interviews with bank managers of three banks in Germany	Task-channel fit, social norms, facilitating conditions. Moderators: age, gender, experience	Intention to use channel	The perceived fit between task and channel is relevant for intention to use electronic channels.
Hong et al. (2008)	Theory of planned behaviour (TPB)	Online survey of 811 MDS consumers in Hong Kong	Usefulness, ease of use, enjoyment, social influence, media influence, mobility, monetary value	Attitude and intention to continued usage	Attitude, social influence, media influence, perceived mobility, perceived monetary value and individual usage context (i.e., MDS categories) influence intention. Perceived ease of use, perceived usefulness and perceived enjoyment

Authors[1]	Theoretical Foundation	Context and Method	Independent Variables	Dependent Variables	Results[2]
					influence attitude.
Kim et al. (2009)	None	Online and mail survey of 206 mobile phone and bank users in South Korea	Relative benefits, personal propensity of trust, structural assurances, firm reputation, initial trust in m-banking	Intention to use	Relative benefits, propensity to trust and structural assurances influence initial trust. Initial trust and relative benefits influence intention. Firm reputation does not influence intention.
Kleijnen et al. (2004)	TAM	Field survey of 105 m-banking users (who used at least once)	Usefulness, ease of use, cost, system quality, social influence, user characteristics: age, computer skills, mobile technology readiness	Attitude, intention	Perceived usefulness and systems quality influence attitude. Social influence and attitude influence intention. User characteristics have moderating effects on the above relationship.
Lee et al. (2007)	None	20 semi-structured interviews with non m-banking users	Risk, lack of knowledge	IS resistance	Well-developed traditional electronic banking services (e.g., Internet banking), perceived risk and lack of knowledge contribute to resistance.
Luarn and Lin	TAM and TPB	Field survey of 180 bank users in Taiwan	Usefulness, ease of use, credibility, self-efficacy,	Intention	Usefulness, ease of use, credibility, self-efficacy influence intention.

Authors[1]	Theoretical Foundation	Context and Method	Independent Variables	Dependent Variables	Results[2]
(2005)			financial cost		Financial cost negatively influences intention to use.
Luo et al. (2010)	None	Survey of 122 students in USA	Performance expectancy, trust, risk, structural assurance, disposition of trust, self-efficacy	Intention	Risk, personal trait factors (self-efficacy, disposition to trust) and performance expectancy influence intention to use.
Tang et al. (2004)	TAM	Survey of 267 mobile phone and bank users in Taiwan	Computer self-efficacy, perceived usefulness, perceived ease of use, perceived credibility	Intention	Computer self-efficacy influences intention through perceived ease of use, perceived usefulness and perceived credibility.
Wang et al. (2006)	TAM and TPB	Field survey of 258 visitors to an e-commerce exposition in Taiwan	Self-efficacy, financial resource, usefulness, ease of use, credibility	Intention to use	Self-efficacy, financial resource, usefulness, ease of use and credibility influence intention to use.
Wu et al. (2005)	TAM and diffusion of innovation theory (DOI)	Survey of 373 online bank, mobile and securities investment company customers	Risk, cost, compatibility, usefulness, ease of use	Intention, actual use	Risk, cost, compatibly, usefulness influence intention to use, which in turn influences actual use. Ease of use does not influence intention to use.

Authors[1]	Theoretical Foundation	Context and Method	Independent Variables	Dependent Variables	Results[2]
Yang (2009)	Rasch measurement model	Survey of 178 students in Taiwan	Speed of transaction, transaction fees, practical banking services, safety, system basic fees	Adoption	Speed of transactions and special reduction in transaction fees, practical banking services and reduced banking transaction fees influence adoption. System configuration safety and system basic fees inhibit adoption.
Zhou et al. (2010)	TTF and unified theory of acceptance and use of technology	Field survey of 250 m-banking users in China	Task characteristics, technology characteristics, performance expectancy, effort expectancy, social influence, facilitating conditions	Task-technology fit, user adoption	Performance expectancy, task-technology fit, social influence and facilitating conditions influence adoption. Task-technology fit influences performance expectancy.

Notes: [1] Sorted in alphabetical order by author's name. [2] Only primary and significant results reported.

3.4.5 *Distribution of Articles by Country Where Data were Collected*

It is not surprising that Finland tops the list, with 11 reviewed articles, followed by South Korea (6 articles). Both these countries are pioneers in m-banking innovations. Germany and Taiwan had four articles each, followed by China and South Africa, with three articles each. Malaysia had two articles on m-banking, while Australia, Ghana, Hong Kong, Indonesia, Japan, Kenya and Spain had one article each (see Figure 3.4). Most of the reviewed articles that did not state the country in which the data were collected were likely to be based either in the US or 'other' European countries (e.g., UK).

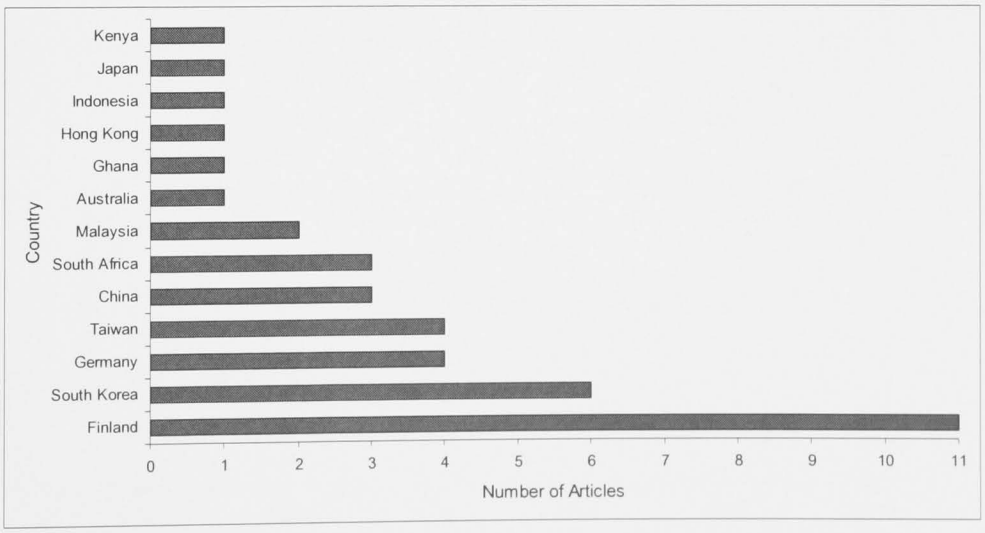


Figure 3.4: Distribution of articles by country

3.4.6 *Distribution by Year of Publication*

The distribution of articles from January 2000 to June 2010 is presented in Figure 3.5. Research output on m-banking increased steadily from 2001 to 2005, but declined in 2006. However, research output since 2007 has been steadily increasing. It is interesting to note that the curve is representative of 'm-banking hype'. From early 2000 to 2005, there was considerable hype about m-banking. Recently, the promise of m-banking has resurfaced, and research output in this area is on the rise again. As at the time of undertaking this study in the second half of 2010, more than half of the yearly research output for 2010 was yet to be published, given that many journals and conference publications appear in the latter half of the year.

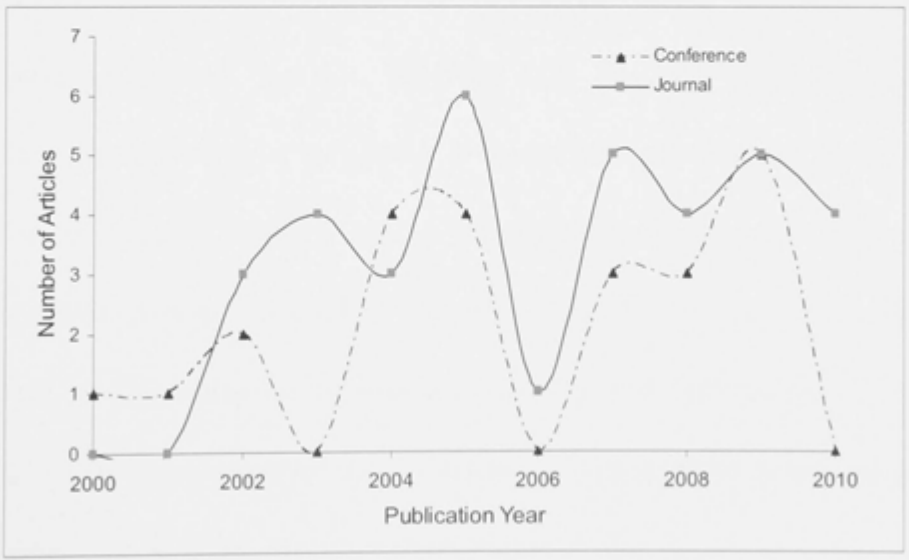


Figure 3.5: Distribution of articles by year

3.4.7 *Distribution of Articles by Journal and Conference*

M-banking articles were published in 21 journals from different disciplines, such as, IS, technology innovation, management and marketing. Most of the articles were published in IS/IT journals, and amongst those journals, Interacting with Computers and the International Journal of Mobile Communications (6 articles each) published the highest number of articles. It is also encouraging that top-tier IS journals, such as Decision Support Systems (3 articles), Information Systems Journal (2 articles), Communications of the ACM (2 articles), Information and Management (1 article) and Information Systems Frontiers (1 article) are increasingly accepting articles on m-banking, and the majority of these articles have been published since 2009. Several articles dedicated to m-banking appeared in the 'basket of six' IS journals (e.g., Information Systems Journal); however, MIS Quarterly and Information Systems Research are yet to publish m-banking articles. Nevertheless, many articles in major IS journals, such as Communications of the Association for Information Systems, Journal of the Association for Information Systems, Journal of Management Information Systems and Information Systems Research, note the importance of m-banking for next-generation banking (e.g., Scornavacca et al. 2006, Nickerson 2008, Tallon 2010).

In terms of conferences, the Americas Conference on Information Systems and the Hawaii International Conference on System Sciences published five papers each. There were three papers each in Australasian Conference on Information Systems, International Conference on Information Systems, International Conference on Mobile Business and Pacific Asia Conference on Information Systems and one paper in European Conference on Information Systems.

3.5 Discussion

The findings of Study 2 (Part I) have several implications. Figure 3.5 shows an increasing trend in m-banking publications. The summary of reviewed articles in Tables 3.2 and 3.3 indicate that m-banking research will prosper in the future. There are still many research opportunities open in this relatively young research field. Below, I outline a number of research implications and potential research questions for future work on m-banking:

- Figure 3.2 shows that there is scant research in category 2 (m-banking applications and cases). Hence, IS researchers can conduct more research on questions such as: How can web-based banking and wireless applications be adapted for m-banking (Nickerson 2008)? Existing web-based banking applications will need to be modified so that m-banking applications can be seamlessly integrated with existing banking

applications in order to make banking services conveniently accessible from any location on mobile devices. However, even though mobility represents a natural human state, users may or may not endorse m-banking as the natural successor to traditional, wired desk-bound electronic banking (i.e., augmentation effect). Further, adapting large and complex banking systems for use with mobile devices presents many challenges, and investigating paradigms for this task can result in new approaches to system design. All of these issues need to be examined.

- Figure 3.2 and Table 3.2 indicate that more research is needed on m-banking behaviour. Some of the prominent IS theories on behavioural acceptance are the technology acceptance model, the task-technology fit theory and the unified theory of acceptance and the use of technology. But do these traditional theories hold equally well when users are no longer tethered to a fixed computer system or a physical branch for their banking activities (Nickerson 2008)? Do these theories apply equally in m-banking context? There have been suggestions that we cannot automatically presume the applicability of these theories to m-banking as usage is mainly driven by individual needs rather than organisational needs, and because mobility represents a natural human

state/desire (Lee et al. 2009b). Further, if forecasts that the future will be a mobile one hold true, then this fact must be considered in our understanding of m-banking (Nickerson 2008). Following Nickerson's (2008) suggestion in the context of mobility, I ask a number of questions in the m-banking context: Does mobility add a new dimension for m-banking that existing theories did not consider when they were proposed? How can these theories be adopted for new user behaviours in the m-banking world? Applying prominent information system theories in the context of m-banking may lead to interesting extensions and conclusions (Nickerson 2008). In addition, interesting new theories may emerge that were not conceived in the fixed and web-based world of banking (Nickerson 2008). Thus, researchers should conduct more qualitative and quantitative empirical studies, perhaps backed by guiding theories, in order to enhance understanding of the underlying characteristics of m-banking, and to help improve the quality and relevance of m-banking research. In other words, research that is more empirical is needed to build our understanding of m-banking services and markets, and to propose or confirm theories.

- Table 3.2 shows that the research on the users' trust in m-banking is in its early stage. M-banking users need reassurance that m-banking

services will not compromise the security and privacy of their financial dealings. Further research is required into user trust and the systems that engender or undermine it.

- Figure 3.2 reveals that a large proportion of the articles reviewed in this study are related to m-banking behaviour, which reflects the popularity of the acceptance of the technology topic in IS literature. It is generally accepted that different factors are important at different stages in the development of an IT artifact. As m-banking develops beyond the early adoption stage, it will be necessary to examine other factors pertinent to its development, for example, more category 5 research on strategic, legal and ethical issues. It will also be necessary to examine behavioural issues regarding switch from other banking channels to mobile banking, which is one of the important issues for the success of m-banking in the future.

- Another interesting research issue is how designers can improve m-banking user interfaces. Figures 3.1 and 3.2 show that there has been negligible research in this area. Mobile devices are necessarily small and they are not meant for full web-screen displays. If mobile phones are to become the device of choice for future banking, HCI designers should

continue their work on interface design, input and output control, and user information processing of mobile messages environments in order to develop applications that function within the physical limitations of mobile devices. Attempts to improve m-banking interfaces should continue to focus on user requirements and new business models.

- Figure 3.2 shows that there are few articles in category 4 (m-banking infrastructure). Mobile devices now have fast processing times, large storage capacities, touch pads and reasonably sized display screens. These enhanced capabilities should be studied further, with the aim of developing new m-banking applications.

- Figure 3.3 reveals that there have been no published laboratory or field experiments that examine user experiences in interacting with m-banking applications. Perhaps this is because much of the literature has focused on pre-adoption and adoption issues, which lend themselves to the survey methodology. However, given that advanced mobile devices (e.g., iPhones and iPads) are now increasingly pervasive, it will be useful to conduct experiments to explore post-adoption issues such as the impact of emerging mobile technologies on users' decision-making.

- Table 3.2 shows that strategic questions are being overlooked, such as: How will m-banking change the next-generation of banking? How can banks interact with their customers using m-banking? Will small banks and big banks use m-banking services differently? Will 'in-person' personal banking services decline (i.e., the substitution effect) in the wake of mobile-based personal banking services? Can m-banking help increase personal services without raising costs?

- Researchers can also explore questions such as: How can m-banking increase business value and user performance? How can m-banking facilitate support and collaboration among players in a supply chain? The number of empirical studies exploring the adoption, use and impact of, and satisfaction with, mobile systems is miniscule compared to the pervasiveness of mobile applications. The impact of m-banking in various business sectors such as supply-chain management, retail, finance and brokerage also needs to be better understood. This will expand the scope of m-banking research from the individual to the organisational level.

- Table 3.2 shows that research on m-banking legal and ethical issues has only just begun to emerge. More research is needed in this area in order

to address the legal and ethical implications of m-banking. Regulatory (i.e., public policy) and technical issues also require attention. M-banking will expose regulatory and policy gaps, and new standards and methods for users' privacy protection and secure data transfer will have to be developed. Similarly, technical standards used to handle the specifics of information publishing tools, user interfaces and transportation are essential to ensure compatibility across an entire network of banks and mobile service providers.

- Table 3.2 shows that almost no work has been done on culture and globalisation. Research needs to address questions such as: What changes need to be made in m-banking services in order to develop seamless and standardised financial systems for global usage? Service providers must understand the cultural differences among consumers around the world and adapt their offerings accordingly. This is a complex problem and an intriguing area of investigation. It would be interesting to carry out comparative studies of m-banking adoption between cultures and countries, particularly between cash and electronic banking cultures. There are many factors that lend themselves to investigation, for example, hedonics, demographics, personality traits and extrinsic motivations.

- Finally, Tables 3.2 and 3.3 reveal that there is scant research on the societal and economic impacts of m-banking. For example, there has been some discussion of the potential for mobile channels to empower women in the developing world in terms of control, security, connection and economic benefits (GSMA 2010a, GSMA 2010c). Can m-banking decrease poverty, and gender, social and digital inequality? Will it affect the microfinance model in the developing world?

3.6 Limitations

Though efforts have been made to present a comprehensive review of m-banking research, this study has its limitations. First, the review excluded some highly technical engineering papers. Second, some relevant articles might have been overlooked because much of the literature had been searched by reading the title, abstract and keywords only. Third, the review did not include journal articles and conference papers from the latter half of 2010 to date as the study was conducted in late 2010. However, even though I do not claim this review article to be exhaustive, it does provide a reasonable amount of insight into m-banking research.

3.7 Summary of Study 2 (Part I)

M-banking has become an increasingly popular topic in the IS domain over the past decade. This study presented a literature review of, and a classification framework for, the existing m-banking literature. Sixty-five articles related to m-banking were published in major journals and conferences between January 2000 and June 2010. They belong to various disciplines including IS, technology innovation, management and marketing. The study classified these articles into five main categories by research topic: (1) overview and conceptualisation, (2) applications and cases, (3) behaviour, (4) infrastructures, and (5) strategic, legal and ethical issues. It also analysed the articles on the basis of research methods, data analysis methods, theories used, countries where data were collected, year of publication, and journal and conference. Several new research questions are also provided that could yield valuable results in the m-banking field.

Chapter 4

Users' Intention to Switch from Other Banking Channels to Mobile Banking: An Expectancy Theory Perspective

4.1 Background of Mobile Banking

M-banking is defined as providing banking services via mobile telecommunication devices such as mobile phones (Mallat et al. 2004). It is regarded as a 'killer application' amongst all MDSs (Economist 2007).

M-banking is generally viewed as a more flexible and ubiquitous service than existing banking channels (Barnes and Corbitt 2003). It has the potential to transform the banking and telecommunication sectors (Kim et al. 2009). It generates revenue for mobile service providers and reduces the costs of providing banking services (Kim et al. 2009). Banks want their users to migrate from branch or ATM services to m-banking services. If m-banking becomes prevalent, it can transform the world's cash-based systems into cashless and truly digital financial systems (Xiangpei et al. 2008). It can potentially create a 'friction-free' global financial system in which money can be sent and received by touching a few keys on a mobile phone (Xiangpei et al. 2008).

Recent progress in wireless technology and rapid proliferation of advanced mobile phones have been advantageous to m-banking (Shin and Lee 2005, Kim et al. 2009). Yet, the take up of m-banking has been low to date. It has become popular in a few countries only such as Japan, South Korea and Finland (Baldi

and Thaung 2002, Bina and Giaglis 2007). Therefore, there is some scepticism as to the likelihood of m-banking evolving into a ubiquitous banking service.

In the late 1990s, banks attempted to attract users to m-banking, but their attempts were in vain (Mallat et al. 2004). That failure was largely attributable to the users not having recognised the full potential of m-banking and that the technology was not sufficiently evolved with ongoing issues in relation to speed, security and design (Wang et al. 2006). Now that the technology has matured and many of these problems have been resolved, major banks in the world are offering m-banking delivery channels (Sharma and Gutiérrez 2010).

Despite this, our understanding of the attractiveness of m-banking is far from conclusive, and there has been little behavioural research on users' intentions to switch from one service channel to another. Prior research generally considered m-banking a standalone application, neglecting the fact that signing on to m-banking almost always requires a user to switch from one form of banking service to another. For instance, prior research took a human–computer interaction perspective on functional and interface requirements of mobile devices for different users (Constantiou et al. 2007). Prior studies also used the technology acceptance model to study the adoption of m-banking (Luarn and Lin 2005) and the dynamics between trust and users' intentions to

use m-banking (Kim et al. 2009). Some researchers examined m-banking from a service quality perspective, focusing on user satisfaction as a dependent variable (Chung and Kwon 2009). Herzberg (2003) studied technical aspects of developing m-banking applications, while Ho (2006) studied the role of Internet personalisation on users' website switching behaviour.

However, as mentioned previously, m-banking is just one service in a bundle of banking services that includes branches, ATMs and online banking. Bank account holders usually perform their banking functions via multiple channels; therefore, research that treats m-banking as a standalone technology application fails to see the overall picture of how users access banking services.

I am not aware of any prior studies that have investigated the issue of users' switching behaviour from other banking channels to m-banking. This switching behaviour is one of the most important issues for the success of m-banking in the future, and the need for more research into this area has been identified in chapter 3. Many academics have also echoed this call for more research with a view to understanding whether current bank users switch from other channels (e.g., branch) to emerging SST channels (Venkatesh 2006, Curran and Meuter 2007). Bank executives are also keen to understand users' acceptance of technology-mediated m-banking (Constantiou et al. 2007). Study

2 (Part II) is intended to answer these calls. Specifically, it aims to answer the following question.

What factors motivate users to switch to m-banking?

The remainder of this chapter is organised as follows. Section 4.2 introduces expectancy theory as the theoretical frame of the study. Section 4.3 describes the proposed model and hypotheses derived. Section 4.4 presents methodology and Section 4.5 discusses the findings. Section 4.6 discusses the theoretical and practical implications of the work and its limitations. Section 4.7 sets out a summary of the study.

4.2 Expectancy Theory

Expectancy theory, originally developed by Vroom (1964), has been the theoretical foundation for a large body of studies in education, psychology, organisational behaviour and management accounting. Expectancy models are cognitive explanations of human behaviour that cast people as active, thinking and predicting creatures in their environment (Chen and Lou 2001). Expectancy theory asserts that the perceived relative attractiveness of various options is related to users' beliefs about the consequences to which each option will lead, and their beliefs about the desirability of those consequences (Chau 1996). According to expectancy theory, users purposefully choose from

alternatives in order to maximise pleasure and minimise pain (Ratzburg 1997). Users assess the potential outcomes of their actions in terms of likely rewards and choose their actions based on the desirability of rewards (Vroom 1964).

According to Vroom (1964), expectancy theory is characterised by three important concepts: valence, expectancy and instrumentality. In other words, users' attitudes under this theory depend on a perceived link between effort and performance (expectancy), a perceived link between performance level and reward level (instrumentality), and satisfaction of the reward (Vroom 1964).

Researchers describe these concepts as follows (Ratzburg 1997, Hann et al. 2007, Davis and Khazanchi 2008). Valence refers to the value that users place on a given outcome (Davis and Khazanchi 2008). An outcome is of positive valence if users want to have it, is of negative valence if they want to avoid it, and is of no valence if they neither want it nor avoid it (Ratzburg 1997). Valence represents users' preferences and is a function of their needs, goals and values (Hann et al. 2007). Users will act to achieve an outcome if they believe there is positive valence in the outcome, and they will be more inclined to perform a task if a positive outcome is perceived to be associated with that task. The more positive an outcome is to users, the more inclined they will be to perform a task associated with that outcome.

Expectancy reflects users' beliefs that a given level of effort will result in a given level of performance (Hann et al. 2007). Users' confidence levels in the skills required to perform a task may contribute to their expectancy belief (Ratzburg 1997). In other words, expectancy is the belief that users are capable of completing tasks or activities (Hann et al. 2007).

Instrumentality refers to the subjective assessment that a given performance level will lead to one or more outcomes (Hann et al. 2007). It is the belief regarding the likelihood that performing one or more tasks or activities will result in one or more desired outcomes. Users will perform well if they believe that a higher level of performance will lead to higher rewards (Ratzburg 1997).

IS researchers apply expectancy theory in different technology contexts. They apply the theory to study users' decisions to approach or avoid new technologies. For example, Chen and Lou (2001) used expectancy theory to investigate why users adopt online learning technology. Other researchers have applied expectancy theory to study the information privacy concerns of online users (Hann et al. 2007), the expectations and satisfaction of end users (Au et al. 2008), and the motivation of software developers to be involved in future open source software development projects (Wu et al. 2007).

4.3 Research Model and Hypotheses

I employ expectancy theory to characterise the variables related to m-banking and predict how these variables affect users' intentions to switch from one banking channel to another. Expectancy theory is useful for my research problem because it models the role of beliefs in decision-making and focuses on the cognitive process that occurs before a behaviour is undertaken or a choice is made (Hann et al. 2007). It helps to explain how an individual chooses between alternative forms of behaviour (Hann et al. 2007). The goal of the model is to understand users' intentions to switch (ISW).

4.3.1 Valence

Valence indicates anticipated satisfaction with, or desirability of, outcomes arising from using new technologies (Hann et al. 2007). It recognises that behavioural action is formed by judgments about the importance of the consequences of the behaviour (Hann et al. 2007). In my research context, users first experience MDSs or m-banking and form a perception about it. Valences cover the degree of mobility of the services (perceived mobility) and users' perceptions of the advantage (perceived relative advantage), which reflect the capability of m-banking to enhance the task performance of a user.

4.3.1.1 Perceived Mobility (PM)

Perceived mobility refers to the extent to which an information system can be accessed independent of time and place (Mallat et al. 2009). Compared to other banking channels, m-banking is distinctly independent (Laukkanen 2007). However, very few studies have examined perceived mobility; for example, Hong et al. (2008) evinced the influence of perceived mobility on users' intentions to continue using MDSs. They found that the association between perceived mobility and the intention to use information content was more salient than the association between perceived mobility and the intention to use mobile entertainment services.

Following expectancy theory, I argue that if users perceive this feature of m-banking to be of valence, they may consider switching to m-banking from their current channel. M-banking could be of particular valence when users have a busy schedule or to make better use of idle time (e.g., waiting for a bus). Mobile services are of particularly high valence when users need to handle routine or emergency transactions to meet efficiency needs (Bina and Giaglis 2007). M-banking can be useful for users who value mobility, and they will be more likely switch to m-banking. Thus, I hypothesise the following:

H1: If users perceive m-banking to be of high mobility, they will have a high intention to switch from other banking channels to m-banking.

4.3.1.2 Perceived Relative Advantage (PRA)

Perceived relative advantage is 'the degree to which an innovation is perceived as being better than its precursor' (Moore and Benbasat 1991, p. 195). Prior research demonstrates that perceived relative advantage has a significant effect on users' intentions to adopt a web channel (Choudhury and Karahanna 2008). Users want to maximise value in their decision-making. Following this, I argue that users will choose a new channel if they perceive it to be more advantageous than traditional channels (Choudhury and Karahanna 2008). Users will also evaluate the desirability of relative advantage leading to valence. A new system that does not help users to perform their job better is not likely to be received favourably, regardless of how carefully it is implemented.

Generally, users develop perceptions of a relative advantage for m-banking in two ways. First, they generally have experience with traditional banking channels (e.g., branch and ATM). If users value the services provided by the current channel(s), then there is no need for them to explore other options. Hence, they are less likely to perceive m-banking to be better than current channels and are less likely to switch to m-banking. Second, users may have

experienced mobile services such as mobile shopping and mobile ticketing. Users who have had satisfying past experiences with other mobile services may be more disposed to switching to m-banking than users who are unfamiliar with mobile commerce. In summary, users assess whether m-banking has a relative advantage over their current banking channel(s). Thus, I hypothesise the following:

> *H2: If users perceive m-banking to be of a high relative advantage, they will have a high intention to switch from other banking channels to m-banking.*

4.3.2 EXPECTANCY

If users evaluate m-banking as a system of valence, they then determine the amount of effort they are willing to exert to switch to m-banking. Users' efforts depend on both technological and user characteristics. For instance, if users perceive m-banking services to be more complicated to use than physical branches or ATMs, they will be less likely to switch to m-banking. If users consider themselves incapable, they may feel that switching to m-banking is beyond them, and thus decide to stick to their current channel. Below, I examine two variables that belong to the category of expectancy: perceived complexity and perceived self-efficacy.

4.3.2.1 Perceived Complexity (PCMX)

Perceived complexity is the degree to which an innovation is perceived as difficult to control (Moore and Benbasat 1991). Generally, users are more likely to choose channel(s) that they perceive as easier to use. Users search for technology that will increase their performance, taking into account how much effort is required to use it. For instance, users tend to consider mobile applications difficult to use because mobile devices have small display screens and small keyboards (Kim et al. 2009).

Therefore, according to expectancy theory, perceived complexity directly affects users' intentions to switch from other banking channels to m-banking. If users perceive m-banking to be complex to use, their expectancy will decrease; that is, they will consider that too much effort is required to switch to m-banking. Thus, I hypothesise the following:

> *H3: If users perceive m-banking to be complex, they will have a low intention to switch from other banking channels to m-banking.*

4.3.2.2 Perceived Self-Efficacy (PSEF)

Perceived self-efficacy is users' beliefs in their abilities to use technologies (Compeau and Higgins 1995). Brown and Venkatesh (2005) suggest that users will not adopt a new technology for household use until they are convinced

that they are able to use it properly. Luarn and Lin (2005) demonstrate the influence of self-efficacy on the intention to use m-banking. Users will view any difficulties associated with switching to m-banking as a 'challenge'. Whether they take up the challenge depends on their self-efficacy (Kim 2009).

Following expectancy theory, I argue that users with high self-efficacy will have high expectancy; that is, they will be more excited about the outcomes (e.g., mobility) of switching to m-banking. Users with low self-efficacy will have low expectancy; that is, they will feel discouraged and be more inclined to stick to their current channel. Thus, I hypothesise the following:

> *H4: If users perceive a high level of self-efficacy, they will have a high intention to switch from other banking channels to m-banking.*

4.3.3 INSTRUMENTALITY

In general, users want to avoid risk and reduce losses (Kahneman and Tversky 1979). Their decision-making and behaviour also tend to be averse to risk and loss because uncertain situations give rise to feelings of incompetence (Brown and Venkatesh 2005). If users think m-banking is risky, they will have negative psychological perceptions and be reluctant to make the switch. In this study, I use a construct—perceived risk—to capture this characteristic. Moreover, when deciding whether to switch to a new technology, users often assess the

financial cost of using the technology relative to their earnings ('perceived financial resources').

4.3.3.1 Perceived Financial Resources (PFR)

Perceived financial resources are the extent to which users believe they have financial resources to pay for the costs of using a technology (Luarn and Lin 2005). In the m-banking context, these costs include the handset, communication time and subscription fees (Wang et al. 2006). Prior research shows that perceptions of adequate resources for acquiring hardware and software can facilitate an intention to use new technology (Mathieson et al. 2001). Wang et al. (2006) evince that perceived financial resources significantly influence intentions to use mobile service transactions.

Given that the cost of accessing mobile and wireless services is higher than that of accessing wire-based Internet services, I anticipate that financial considerations might influence users' behavioural intentions to switch to m-banking from other channels. Following expectancy theory, I argue that if users perceive that they are financially sound; that is, that they have sufficient financial resources, they will be more inclined to use m-banking service for convenience and/or higher performance. Overall, I anticipate that users with

high financial resources are more likely to switch to m-banking than users with lower financial resources. Thus, I hypothesise the following:

> *H5: If users perceive that they have the necessary financial resources, they will have a high intention to switch from other banking channels to m-banking.*

4.3.3.2 Perceived Risk (PR)

Perceived risk refers to the risk of loss of privacy (via disclosure of personal and financial information) and the risk of monetary loss (Pavlou 2003). Prior research suggests that risk plays an important role in electronic commerce transactions (Pavlou 2003). According to expectancy theory, users want to be more instrumental by trying to avoid risk when deciding on a new technology. As such, users may be reluctant to provide sensitive personal information and to conduct financial transactions via m-banking (Luarn and Lin 2005).

New technology-enabled services may exhibit unfamiliar and ambiguous stimuli, creating uncertainty for users. M-banking is a relatively new technology-enabled channel and users may believe that switching to m-banking is a risky decision. Thus, I hypothesise the following:

H6: If users perceive m-banking to be riskier than other channels, they will have a low intention to switch from other banking channels to m-banking.

The research model is depicted in Figure 4.1. I collected 493 data points to test the above six hypotheses, and my survey design and findings are presented below.

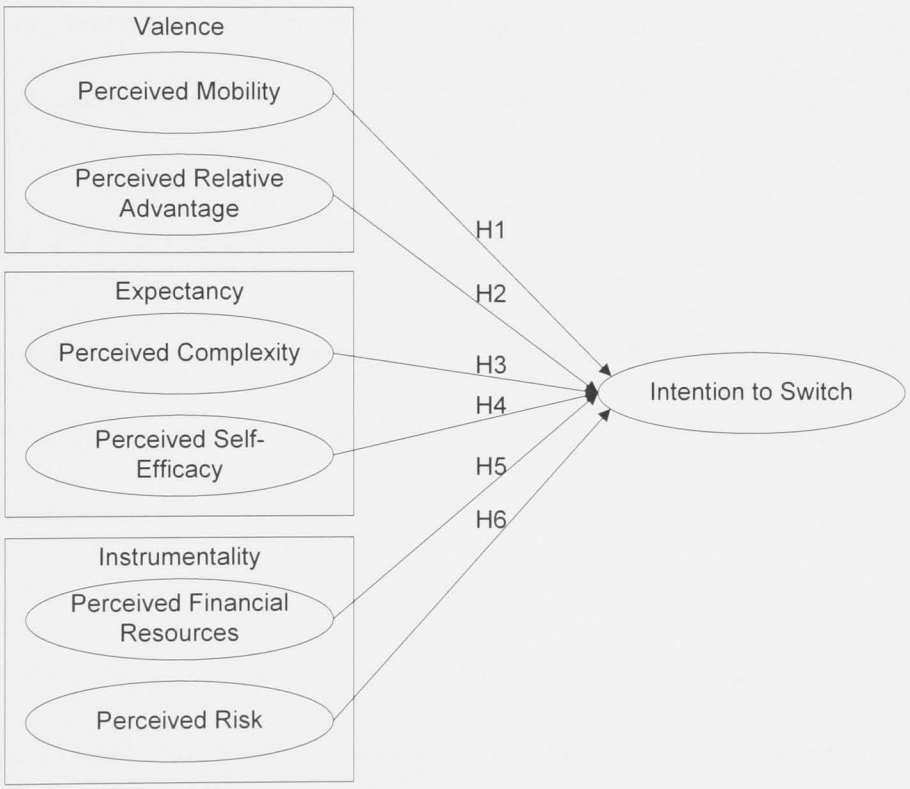


Figure 4.1: M-banking research model

4.4 METHODOLOGY

I conducted a survey to collect the data to test the above hypotheses. I chose the survey method over other methodological alternatives because it is an appropriate method for researching self-reported beliefs and attitudes (Neuman 2006). The survey approach also allows me to collect data from mobile phone users in a natural setting without any interference. Study 2 (Part II) collected data on demographics, perceptions of m-banking and intentions to switch to the m-banking channel.

4.4.1 PARTICIPANTS

The survey was conducted at a public university event attended by students, their families, visitors and academics. Two thousand paper questionnaires were distributed and I received 493 usable responses, which is an overall response rate of 24.65%. Of the 493 respondents, 67% were students, 69% were male and 68% were aged under 26. The survey participants were mobile phone users who also used some form of banking service. Bank users were an appropriate sample because they were reasonably knowledgeable about banking services and understood their own needs for various banking services. They were also potential or current users of m-banking services. Thus, my sample is capable of giving reliable and useful responses on both mobile technology and m-banking.

4.4.2 *Instrument Development*

My questionnaire was divided into two parts (see Appendix A for the list of items and Appendix B for the questionnaire). The first part contained ordinal questions for respondents to report their banking channel preferences. It also contained questions regarding how often they used a variety of banking channels. The second part contained several seven-point Likert scale questions for respondents to report their general perceptions of m-banking and their intention to switch to m-banking.

In the first part of the questionnaire, participants were asked to rank and score 16 m-banking functions, including checking account balances, transferring funds, trading stocks, paying bills and receiving alerts. Seven of these functions were related to payments or monetary transactions (e.g., purchasing movie tickets or ringtones). I asked participants to rate each m-banking function on a scale ranging from no intention (1) to high intention (7), with a neutral point (4) in the centre. The participants also reported their general perceptions of five banking channels: branch, ATM, Internet banking, phone banking and m-banking. I surveyed participants' perceptions of specific banking functions for each of these banking channels. I asked participants how often they used the given channel for banking, and I operationalised frequency as eight categories,

ranging from 'never' to 'several times a day'. I also surveyed diversity of use by asking participants questions such as 'What do you use your mobile phone for?'

The second part of the questionnaire was related to perceptions, and items were measured on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree). The independent variables in this study were perceived mobility, relative advantage, complexity, self-efficacy, financial resources and risk. The dependent variable was users' intentions to switch from other banking channels to m-banking. All the perceptual items were adapted from validated scales used in previous studies. To ensure content validity, I referenced several survey instruments in developing my questionnaire: the technology acceptance model (Davis 1989), the perceived characteristics of innovating (Moore and Benbasat 1991), and the innovation diffusion theory (Rogers 1995). The perceived mobility scale was adapted from Hong et al.'s (2008) study. This approach safeguards against concerns about social desirability bias or acquiescence of self-reported data. All items were phrased with respect to the m-banking context of the study.

To ensure the face and content validity of my measures, I reviewed the instrument with two IS academics who are experts in scale development. I conducted a pilot test of five individuals who had rich experience in mobile

commerce, and who were actively using technology-based bank services (three students and two professionals), in order to assess the readability, length and clarity of the instrument. It took the participants approximately 20 minutes to complete the questionnaire. Based on their feedback, I refined the instrument further, presented them with my modified questionnaire, and they confirmed that there were no unclear statements in the modified version.

4.5 FINDINGS

4.5.1 DESCRIPTIVE STATISTICS

Part 1 of my survey gave rich descriptive information on the channels that users preferred. My survey revealed that users ranked m-banking as the highest of all five channels. M-banking scored an average of 3.27 (1 = least preferred, 5 = most preferred). Internet banking transactions were the second most preferred, with an average score of 3.13. The next two equally preferred channels were physical branches and ATMs, both with means of 3.02. Phone banking was ranked the lowest, with an average score of 2.25.

My findings revealed the channel(s) preferred by users for certain banking functions. For instance, users preferred m-banking for locating a branch or an ATM (mean = 3.88), and receiving SMS alerts when performing critical

transactions (3.72). Users also preferred m-banking for stock trading, with an average score of 3.43. Moreover, they preferred to use m-banking to pay phone bills (3.82) and utility bills (3.58), and to receive credit card related alerts (3.73). The preference for using Internet banking to pay phone bills (3.44), utility bills (3.00), and to receive credit card related alerts (3.21), were lower compared to m-banking. Further, paying utility bills at branches and ATMs only scored an average of 2.92 and 2.72 respectively.

4.5.2 Model Testing

The properties of the theoretical model were tested following a measurement and structural approach (Gefen et al. 2000). I used partial least square (PLS) to validate the measurement and structural properties of the model. PLS was a suitable choice for the analysis given that my research was oriented to developing theory and new measures (Chin 1998).

4.5.3 Measurement Validation

I first assessed the reliability, discriminant validity and convergent validity of the constructs. I used internal consistency scores to assess reliability. Table 4.1 shows composite reliability scores. The internal consistencies of all constructs

were considered acceptable because they all exceeded the recommended threshold of 0.70 (Gefen et al. 2000).

I used two criteria to assess discriminant validity. First, I checked whether the items loaded much higher on their hypothesised factor than on other factors (own loadings are higher than cross-loadings). All items in constructs loaded more highly than their cross-loadings. Second, I checked whether the square roots of each factor's average variance extracted (AVE) were larger than its correlations with other factors (Chin 1998). As shown in Table 4.1, the square root of all AVEs was much larger than all other cross-correlations. Therefore the discriminant validity was satisfactory.

I used two criteria to assess convergent validity. First, I assessed the AVE for all constructs. Convergent validity was confirmed because the AVEs for all constructs were higher than the recommended threshold (> 0.5). Second, I assessed the significance of item loadings on their factors. As all items loaded highly on their constructs, it confirmed that convergent validity was satisfactory. Together, these findings suggested adequate convergent and discriminant validity.

Table 4.1: Descriptive Statistics, Correlation Matrix, and AVE of Principal Constructs

	Mean	Reli-ability	PCMX	PFR	PM	PR	PRA	PSEF	ISW
PCMX	3.46	0.82	**0.83**						
PFR	4.09	0.91	0.32**	**0.92**					
PM	5.67	NA	–0.14**	–0.14**	NA				
PR	4.30	0.85	0.27**	0.19**	-0.00	**0.81**			
PRA	5.34	0.90	–0.06	–0.11**	0.50**	–0.05	**0.80**		
PSEF	5.30	0.84	–0.00	–0.07	0.38**	–0.07	0.46**	**0.80**	
ISW	5.41	0.90	–0.16**	–0.05	0.58**	–0.05	0.53**	0.49**	**0.90**

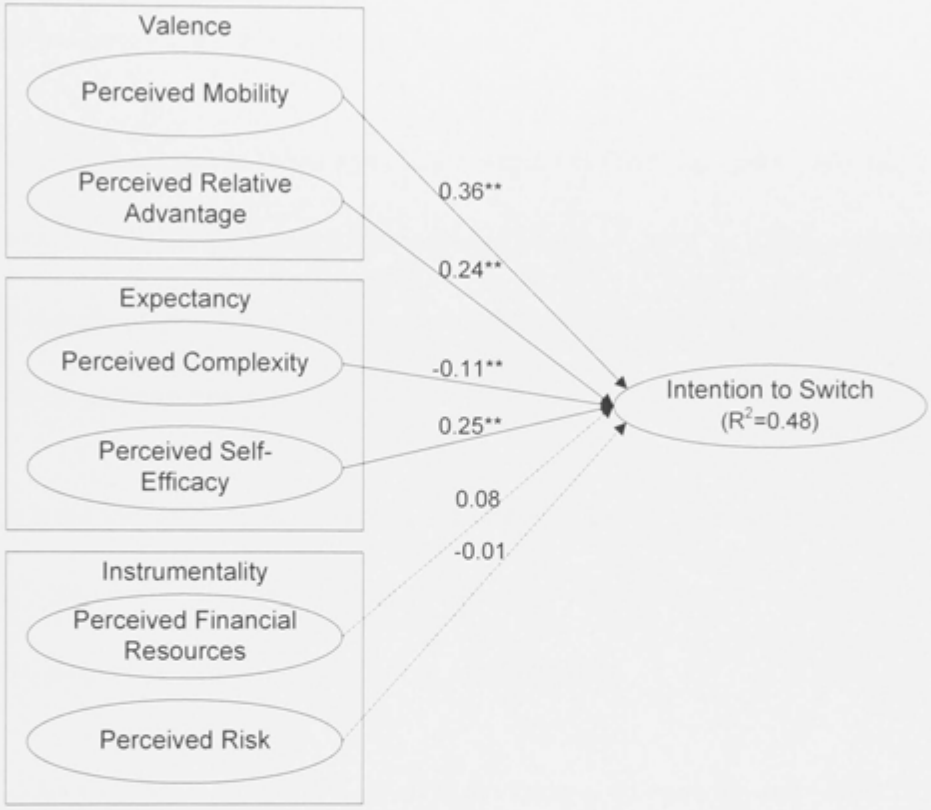
**p<0.01. Diagonal elements (in bold) represent square root of AVE. NA (Not applicable).

My research was vulnerable to common method biases because the survey data were self-reported, and dependent and independent variables were measured simultaneously. To assess common method biases, I conducted a Harman's one-factor test (Podsakoff et al. 2003). Specifically, I performed an exploratory factor analysis on all variables and found that the threat of common method biases was low.

4.5.4 Structural Validation

The total variance explained by the intention to switch from other channels to m-banking was 48% (R^2 = 0.48). Figure 4.2 depicts the standardised path

coefficients and the explained construct variances, and Table 4.2 lists the findings of the structural model analysis and their statistical significance.



Notes: **p < 0.01. Dotted line indicates insignificant influence.

Figure 4.2: Structural model

As hypothesised, perceived mobility has a significant main effect on users' intentions to switch from other channels to m-banking ($\beta = 0.36$, $p < 0.01$), thus supporting H1. Results show that users who perceive the high mobility of m-banking are more likely to make the switch.

Perceived relative advantage also has a significant effect on users' intentions (β = 0.24, $p < 0.01$), which supports H2. Results show that users who perceive that m-banking provides them with a relative advantage are more likely to switch to m-banking from other banking channels.

Perceived complexity has a significant negative effect on users' intentions to switch from other channels to m-banking (β = -0.11, $p < 0.01$), thus supporting H3. Results show that users who perceive m-banking to be complex are less likely to make the switch.

Perceived self-efficacy has a significant effect on users' intentions (β = 0.25, $p <$ 0.01), thus supporting H4. Results show that users who perceive a high level of self-efficacy are more likely to switch to m-banking.

Together, perceived mobility, relative advantage, complexity and self-efficacy account for 48% of the variance in users' intentions to switch from other banking channels to m-banking. Surprisingly, perceived financial resources (β = 0.08, $p > 0.10$) and perceived risk (β = -0.01, $p > 0.10$) have no significant effect on users' intentions to switch from other channels to m-banking. Thus, H5 and H6 were not supported in this study.

4.6 Discussion

In this section, I present my key findings, followed by the theoretical and practical contributions.

4.6.1 Key Findings

Table 4.2 summarises the results of the tested hypotheses.

Table 4.2: Summary of Findings

Hypotheses		*p* value
H1:	If users perceive m-banking to be of high mobility, they will have a high intention to switch from other banking channels to m-banking.	< 0.01
H2:	If users perceive m-banking to be of high relative advantage, they will have a high intention to switch from other banking channels to m-banking.	< 0.01
H3:	If users perceive m-banking to be complex, they will have a low intention to switch from other banking channels to m-banking.	< 0.01
H4:	If users perceive a high level of self-efficacy, they will have a high intention to switch from other banking channels to m-banking.	< 0.01
H5:	If users perceive they have the necessary financial resources, they will have a high intention to switch from other banking channels to m-banking.	n.s.
H6:	If users perceive m-banking to be riskier than other channels, they will have a low intention to switch from other banking channels to m-banking.	n.s.

n.s. (Not supported.)

Perceived mobility has the strongest path coefficient of all the factors in my model. Hence, perceived mobility is the key motivating factor for users to switch from other banking channels to m-banking. This suggests that users who have positive valences to bank anywhere and anytime will have a high intention to switch to m-banking (H1). Perceived relative advantage, as expected, is another important predictor of users' intentions to switch to m-banking; that is, if users have positive valence for a new technology over an incumbent technology, they will be motivated to switch to the new technology (H2).

As expected, perceived complexity is negatively associated with users' intentions to switch to m-banking; that is, perceived complexity increases effort expectancy and, consequently, de-motivates users from switching to m-banking (H3). Conversely, perceived self-efficacy decreases users' effort expectancy; that is, it increases their confidence in their ability to carry out the action successfully and, consequently, increases the likelihood of switching banking channels (H4).

Based on prior literature, I expected perceived financial resources to be positively associated with users' intentions to switch to m-banking. However, contrary to my hypothesis, perceived financial resources had an insignificant

effect on users' intentions to switch to m-banking (H5). This result can be explained by Venkatesh and Brown's (2001) suggestion that cost-related factors may not be significant if the cost is perceived as lower and the usefulness is perceived as higher. In the context of this study, since perceived mobility and relative advantage have emerged as highly influential, the relationship between perceived financial resources and the intention to switch to m-banking may have become insignificant. Further, based on prior literature on users' risk perceptions, I expected perceived risk to be a significant predictor of the intention to switch. However, contrary to my hypothesis, perceived risk had an insignificant effect on the intention to switch (H6). One possible reason for this result is that the effect of perceived risk on the intention to switch diminishes if users believe a new technology will be useful and convenient (Curran and Meuter 2007). However, this finding warrants caution in some contexts, as most of my data were collected from university students who were likely to be more technologically well informed than the general population.

4.6.2 *Theoretical Contributions*

Study 2 (Part II) contributes to the existing literature in several ways. First, it signifies an important step in the development and testing of a theory related to users switching from one channel to another in order to conduct their activities

via technology-mediated alternatives. It is an attempt to overcome the current IS research trend of examining specific technologies in isolation. Specifically, I use banking as my research context. The study also augments prior studies on m-banking, which predominantly used the technology acceptance model to study users' technology adoption behaviour (Venkatesh 2006). However, as mentioned previously, m-banking is not a standalone technology; it is one option in an array of banking services. Hence, I believe that switching behaviour from another banking channel to m-banking is more appropriate in this context. Further, the study contributes to emerging domestication research of MDSs by introducing a complementary theoretical framework, built on expectancy theory, to theorise the channel-switching issue in banking.

Finally, in this era of technology-mediated channels, individuals are not restricted to utilise one single channel exclusively. The study attempts to provide a holistic picture of mobile users' behaviour along this line. Specifically, I theorise the effects of perceived mobility, relative advantage, complexity, self-efficacy, financial resources and risk on users' intentions to switch. Some variables (e.g., perceived self-efficacy) relate to user control characteristics, whereas some variables (e.g., perceived mobility) relate to new technology characteristics. These variables belong to different categories in expectancy theory (i.e., valence, expectancy and instrumentality). Overall, my

research model presents a big picture of different types of variables in the m-banking context.

4.6.3 *Practical Implications*

The results of Study 2 (Part II) are valuable and, in the midst of the proliferation of SSTs and the growth of the online services industry, they are relevant to retail managers, wireless site designers and consumers. Specifically, the study is important for managers in banks who are considering the implementation or expansion of m-banking as an SST in their service delivery, as it sheds light on factors that might be salient to targeted users. The introduction of m-banking offers customers a variety of banking options, and this study helps to better understand why users may switch to m-banking.

M-banking can provide tremendous cost savings for banks if it is widely used; however, it can be very costly if it is not implemented and introduced correctly. When IBM shifted their call centre service to an SST channel, they saved US$2 billion (Burrows 2001). However, a Forrester Research study found that 41% of firms that were studied observed no return or savings on their self-service investments (Zurek et al. 2001, Curran and Meuter 2007). Presumably, firms do not share a common understanding of how to leverage SST. The study

sheds light on the technological features which are important to attract users to mobile SST.

Factors such as perceived mobility and relative advantage have been found salient in switching behaviour. In a similar vein, highlighting the value that can be derived from using m-banking (i.e., valence) represents a potentially fruitful exercise. To encourage individuals to utilise m-banking, service providers should build the perception that conducting a number of activities will result in greater rewards such as cost and time savings, and ubiquity. Communicating these types of rewards, such as 'Free your time', which was used by one bank, is likely to sway users towards the mobile channel, generating a competitive opportunity for MDS providers.

Perceived self-efficacy and complexity have been salient in driving and inhibiting switching behaviour, respectively. Service providers should design marketing messages such as 'You are in control' to supplement efficacy beliefs and ease users' anxiety about difficulty (Looney et al. 2008). Self-efficacy can also be manipulated through online education, training and support; thereby developing a 'Do it yourself' mentality by inducing individuals to believe that they can take advantage of mobile SST (Looney et al. 2008). The availability of around-the-clock online help and customer service may put individuals at ease

and increase their sense of confidence so they can utilise m-banking services successfully (Looney et al. 2008).

Finally, we are already in the decade of wireless technology, and firms must plan for a mobile future. As users continue to become more familiar and comfortable with m-banking, it is critical that banks and mobile service providers understand how to best offer m-banking services. Overall, the study generates useful insights into the strategies that will enable banks to increase their market share in a highly competitive environment. It will help managers to better understand mobile users' behaviour, and invest in 'suitable' m-banking infrastructure.

4.6.4 LIMITATIONS

Study 2 (Part II) is not without limitations. First, 67% of the survey respondents were students; however, I consider this a legitimate sample because most mobile users are young (Okazaki 2006). Future work could replicate this study with office workers or homemakers. Second, the current model only explained 48% of the variance in users' intentions to switch. Future work should explore more variables to increase the predictive power of the model. Finally, I focus on m-banking in the study because it is a 'killer application' in mobile commerce (Economist 2007). However, is my model

applicable in other channel-switching contexts? It would be useful to test the relationships found here in contexts such as physical versus mobile ticket purchasing to determine whether the same switching behaviour is observed. More research needs to be conducted to generalise this finding.

4.7 Summary of Study 2 (Part II)

The rapid proliferation of advanced mobile devices has made m-banking an attractive option for banks and mobile service providers; however, consumer demand for m-banking is still low. In Study 2 (Part II), I developed a model, anchored by expectancy theory, and validated it using data collected from 493 mobile phone users to predict intentions to switch to m-banking. My findings suggest that perceived mobility, relative advantage and self-efficacy are positively related to user intentions to switch banking channels. Perceived complexity is negatively related, and financial resources and risk are not related to user intentions to switch.

Chapter 5

The Effects of Learners' Personality Traits on their Attitude and Behaviour towards Mobile Learning

5.1 Background of Mobile Learning

Mobile communications play an influential role in modern life. They have become essential for individuals on the move, in gathering information, and in making plans and executing them. One activity that is highly influenced by mobile communication is learning (Naismith 2007). Learning has adapted to this changed lifestyle, and learning methods have become more portable and flexible (Zhang and Nunamaker 2003). The proliferation of mobile phones and other mobile devices has evolved m-learning from a research endeavour to an everyday activity, where personal mobile devices are enabling people to learn anytime and anywhere. This is why m-learning has grown out of electronic learning (e-learning) in such a short time and has become a self-determining approach to flexible learning (Horvath et al. 2009). It has been adopted by many educators and businesses (Johnson et al. 2011). For instance, the Massachusetts Institute of Technology (MIT) has invested in infrastructure that supports m-learning by sponsoring programs that provide mobile devices to students and commissioning m-learning applications to serve students and instructors (Johnson et al. 2011). The m-learning market, according to a recent report by Ambient Insight, in the US reached US$958.7 million in 2010. This market is projected to grow at a five-year compound annual growth rate of

13.7%, and revenues to educators and businesses are expected to reach US$1.82 billion by 2015 (Adkins 2010).

M-learning enables educators and businesses to efficiently keep in touch with learners. It facilitates a cost-effective learning environment that enables self-paced and interactive learning (Zhang and Nunamaker 2003), and enhances teaching interactivity and learning collaboration. It also represents a shift from instructor-centric learning to student-centric learning, which emphasises content that is relevant to one's interest and learning style (Zhang and Nunamaker 2003). It adds a new dimension to student–instructor interactions and a positive attitude among the students towards the instructor and learning (Rau et al. 2008). As nearly all people in developed countries are equipped with a mobile phone, the objective of m-learning has been to move from a wired learning environment to the wireless ubiquitous learning environment of tomorrow (Naismith et al. 2004). The concern is how educators and businesses can provide the platform, contents and stimulation of learning for increasingly mobile learners (Horvath et al. 2009). This has led to a call for more research on m-learning (Ngai and Gunasekaran 2007).

For businesses, learning is an inescapable element of conducting business in the modern economy. With the increasingly significant role of professional skills

and expertise in organisational development, m-learning is receiving greater attention. Businesses increasingly need to offer flexible learning to their employees, and many have begun to deliver training programs via mobile devices (Donnelly 2009). With m-learning, they can provide their employees with just-in-time training that is cost-effective and flexible (Zhang and Nunamaker 2003).

However, the issue of how m-learning can help provide a better learning experience is still unresolved (Naismith 2007). Prior research has also identified a number of disadvantages, such as a small screen size or keyboard, a limited memory size, a short battery life, the inconvenience of carrying an additional device and the difficulty of designing effective learning content (Liu 2009). This leads to doubt about the effectiveness of m-learning.

Nonetheless, m-learning is believed to place educators and businesses at the forefront of pedagogical excellence of practice in response to modern-day learners' increasingly mobile requirements to access information anytime and anywhere. The mobile learning process can be interactive and stimulating; for instance, learners and instructors can upload questions and opinions to a mobile site and share their learning experiences. Learners can receive immediate feedback and guidance from the instructor, who is simultaneously

online. Incorporating mobile devices in the learning process results in a paradigm shift in the way individuals learn; that is, from the classroom to the pocket. However, there has been little research into the effectiveness of mobile devices in stimulating learners to learn. Therefore, Study 3 aims to provide empirical evidence to help evaluate the effectiveness of incorporating mobile devices in learning. In particular, I focus on one of the basic functions of mobile phones—text messaging—and examine the effectiveness of using text messages to stimulate students' access to learning materials.

Education literature suggests that learners' personality traits influence learning outcomes (DiTiberio 1996). Chamorro-Premuzic and Furnham (2003) examined the relationship between personality traits and academic performance, and found that personality traits assessed during the early weeks of the academic year were significantly related to academic results at later years. Further, when the predictability of personality traits was related to academic behaviour (e.g., class attendance and essay writing) and the instructor's predictions, personality traits accounted for an additional unique variance of 10–17% in academic performance (Furnham et al. 2002). Therefore, this study investigates how learners' personalities influence their behaviour towards m-learning.

Among various personality instruments, I adopt the MBTI. Since its early inception, MBTI has been used to study how personality traits relate to learning aptitudes and outcomes (Harrington and Loffredo 2010). It has been used to assess learners' characteristics including learning styles, interactions with instructors and learning outcomes (DiTiberio 1996). For example, Harrington and Loffredo (2010) found that introverted learners preferred web-based learning, while extroverted learners preferred face-to-face classes. Dewar and Whittington (2000) found that feeling-type learners preferred face-to-face instruction, while thinking-type learners preferred a web-based learning environment. Although there is some evidence to suggest that MBTI types affect learning, it is mainly in the context of web-based learning. There has been little research into the effects of MBTI personalities on an individual's attitude and behaviour towards m-learning. MBTI is adopted in this study because it focuses on how people process information to make decisions, which is the primary facet of learning. It is also a leading personality instrument, having been researched, evaluated, revised and scrutinised for over 70 years (Lucas 2007). My interest is in how text message services can complement and stimulate web-based learning activities.

The objective of this study is two-fold. First, I examine the use of m-learning messages to fully exploit its ability to stimulate students to access course

materials. Technology designers sometimes forget the fundamentals in their eagerness to embrace technology. Although the term 'm-learning' is now embedded in the academic and corporate vernacular, most trainers find themselves doing little more than scattering mobile technologies within training programs at random, hoping that some of them will work. These technologies add little or even no value to the learning process (Roschelle 2003). Obviously, the 'build it and they will come' approach is not effortless. Second, I examine the effects of m-learning messages on stimulating learners to access course materials (De Jong and Ferguson-Hessler 1996). In particular, I examine how learners' personalities influence their learning preferences. Prior studies have developed 'personalised' learning applications, but most applications only consider the difficulty of the teaching materials. Smarter students take harder lectures and weaker students take easier lectures. Educators generally believe that the psychology of human differences is fundamental to learning (Wan et al. 2008). Chen et al. (2006) developed learning systems that personalised schedules for individual students. These studies support a general idea that learning environments are more effective if they capitalise on the characteristics of both learning tasks (i.e., reading course materials or participating in a discussion forum) and the individual (i.e., personality). Therefore, Study 3 addresses the following two questions:

Question 1. What are the effects of text messaging on stimulating learners to access course materials?

Question 2. What is the role of the personality in affecting learners' responses to m-learning messages?

The remainder of this chapter is structured as follows: Section 5.2 reviews the literature on learning, learners' personalities and MBTI personality types in order to shed light on the personalisation of m-learning to learners' personalities. Section 5.3 describes the hypotheses of Study 3. Section 5.4 details the field study on m-learning and its findings are presented in Section 5.5. Section 5.6 discusses the theoretical and practical implications of Study 3 and its limitations. A summary of Study 3 is presented in Section 5.7.

5.2 Literature Review

5.2.1 From Web-based Learning Towards M-Learning

Prior research in the IS field has examined the use of technology in learning; however, it has mostly focused on web-based learning (Piccoli et al. 2001, Xu and Wang 2006, Shen et al. 2008, Wan et al. 2008). Web-based learning refers to the use of the Internet to deliver information and instruction to learners (Welsh et al. 2003, Chiu et al. 2007, Wan et al. 2008), and it is a major

subcomponent of the broader term 'e-learning' or 'distance learning' (Chiu et al. 2007). Web-based learning delivers learning content anytime and anywhere, and provides learners with a customised, interactive and just-in-time learning experience (Piccoli et al. 2001, Xu and Wang 2006, Narciss et al. 2007, Woo and Reeves 2007, Shen et al. 2008). It has emerged as a new paradigm of learning that aims to create various platforms for flexible learning in order to intensify learning activities for learners and to develop their competence (Wang 2011). The effectiveness of web-based learning has been subject of a number of studies. For instance, Woo and Reeves (2007) studied whether an increase in interactions on the web-based learning platform leads to meaningful learning outcomes. Narciss et al. (2007) presented the results of a large-scale project that developed an authoring tool to support web-based education. Piccoli et al. (2001) conducted an empirical study to examine the effects of web-based learning, including instructors' and learners' performances, self-efficacy and satisfaction. Arbaugh (2000) studied the effects of technological, pedagogical and individual characteristics on the effectiveness of web-based learning. In another study, Arbaugh and Benbunan-Fich (2007) examined the effects of learners' interactions with their peers and instructors, and the system of learning.

In contrast to web-based learning, there is little empirical work and no theoretical framework on m-learning. M-learning refers to the acquisition of any knowledge and skills using mobile technology, anywhere and anytime (Liu et al. 2010), and it facilitates online learning activities through a range of mobile devices (Liu et al. 2003). Horvath et al. (2009) identified four types of mobile devices used in the m-learning process: (1) portable computers, (2) mobile communication devices (e.g., mobile phones, smart phones and iPhones), (3) digital assistance devices (e.g., PDAs and iPods) and (4) embedded communication devices (e.g., GPS). The communication technologies used to establish connectivity among the portable devices include (1) wireless Internet, WLANs and wireless application protocol, (2) mobile phone networks, including global system for mobile communications (GSM), general packet radio service and universal mobile telecommunications system cellular networks (UMTS); (3) local *ad hoc* networks, based on Wi-Fi, Bluetooth and infrared data association, and (4) satellite networks (Horvath et al. 2009). Sharma and Kitchens (2004) suggested that the advent and subsequent development of m-learning indicates a profound evolution from distance learning to web-based learning to m-learning.

Researchers have identified a number of benefits of m-learning for educators and businesses, many of which can be adapted from e-learning. M-learning

indeed inherits some benefits from e-learning. The following lists a number of m-learning benefits (Welsh et al. 2003, Zhang and Nunamaker 2003, Naismith et al. 2004, Sharma and Kitchens 2004, Rau et al. 2008, Liu et al. 2010):

(1) 24/7 access to learning materials: M-learning allows unlimited access to learning materials on mobile devices from any location (Zhang and Nunamaker 2003). Since m-learning materials are available to learners 24 hours a day, learners can review current or past learning materials stored in online knowledge repositories over and over again (Zhang and Nunamaker 2003, Sharma and Kitchens 2004).

(2) Increased interaction with the instructor: M-learning encourages learners to increase interaction with their instructor (Rau et al. 2008). In an m-learning environment, learners usually have more opportunities to seek help from their instructor instantaneously than those in a traditional classroom (Zhang and Nunamaker 2003).

(3) Greater collaboration in learning: M-learning supports collaboration and informal interactions among peers and the instructor (Welsh et al. 2003). It also facilitates physically separated learners and the instructor to collaborate, forming an effective online learning community (Zhang and Nunamaker 2003). M-learning also enables learners to ask questions that they may not otherwise

ask in a conventional classroom environment, and to share opinions and ideas without inhibition (Zhang and Nunamaker 2003).

(4) Personalised learning: M-learning fosters 'self-directed and self-paced learning by structuring learner-centric activities' (Zhang and Nunamaker 2003). It can enhance the learning experience by providing interactive and personalised learning content at convenient times and locations (Sharma and Kitchens 2004). It can also provide location-based learning (Naismith et al. 2004).

(5) Convenience and effectiveness: M-learning provides learning convenience by eliminating the barriers of time and distance to access learning materials (Welsh et al. 2003). It increases learners' convenience and learning effectiveness by facilitating just-in-time training when it is needed on the job (Zhang and Nunamaker 2003). It contributes to improved accessibility, interoperability and reusability of learning materials (Liu et al. 2010).

(6) Provision of consistent training: Businesses can ensure consistent training across multiple locations (even around the world) through asynchronous m-learning, followed by customised local classroom training to maintain consistency and to provide localised learning activities to learners (Welsh et al.

2003). They can maintain uniformity in training and offer training to a huge number of learners at the same time.

(7) Low cost and time savings: M-learning can result in significant cost and time savings (Zhang and Nunamaker 2003). It helps businesses save money on training, which would otherwise be spent on travel, classroom costs and time off the job (Liu et al. 2010, Sharma and Kitchens 2004).

(8) Tracking and auditing: An m-learning system is able to track learners' activities (Welsh et al. 2003). It also allows auditing of the learners' mastery of the materials (Welsh et al. 2003). It never loses patience with learners and encourages them to learn by maintaining quality and consistency of learning materials (Zhang and Nunamaker 2003).

(9) Narrowing the learning 'divide': M-learning helps extend learning opportunities to all socio-economic levels, particularly to those previously unreachable from traditional education approaches, such as school dropouts. It enables a highly situated, personal, collaborative and long-term learning experience, which leads to a truly learner-centric learning environment (Naismith et al. 2004).

According to the Horizon Report (2007), the rapid enhancement of the capacity of mobile phones is contributing to an increasingly important role in education (TNMC 2007). Researchers suggest that, instead of simply adapting the existing e-learning techniques to mobile devices, m-learning should be used to exploit the new possibilities offered by mobile devices in an innovative and efficient way (Horvath et al. 2009). M-learning messaging is more likely to add to, and blend with, web-based and face-to-face learning, rather than replacing it (Kim et al. 2007).

In addition, some studies reveal the effectiveness of text messaging services in gaining learners' attention. Text messaging services are more reliable than e-mail in reaching the recipient for time-critical administrative communication (e.g., delayed start of a lecture). Naismith (2007) advised that effective administrative messages should be relevant, simple, time-critical and trustworthy, and found that notices of relevant learning activities are the most popular type of message among students. Traxler and Riordan (2003) used a text messaging system to provide learning support (e.g., alerts and reminders), to distribute feedback on assignments and to provide revision tips to students. These studies showed that students are generally supportive of text messaging communication for learning, as long as no cost is incurred. Research also suggests that students are generally more supportive of texting for

administration purposes than for course content. The use of text messaging increases interactivity and learning opportunities among students and the instructor (Markett et al. 2006). Thornton and Houser (2004) showed learning benefits when pedagogical messages are sent via text message to students' mobile phones, as opposed to e-mailing or posting on a website. Overall, these studies highlight the potential of text messaging to support learning.

5.2.2 *Learners' Personality and Learning Outcomes*

Prior research on personality reveals the relationships between personality types and learning outcomes (Moore and Kearsley 1996). Learners with different personality types have different academic priorities that will affect learning outcomes (Kanuka and Nocente 2003, Clark and Schroth 2010). Furnham and Medhurst (1995) examined how the personality relates to different learning activities such as comprehension of subject matter, essay writing, oral expression, work habits and the degree of participation. They found a significant relationship between personality and learning activities, and a lesser relationship between the personality and academic results. Caspi et al. (2006) studied the relationship between personality traits and social participation in the class. Furnham et al. (2002) observed significant correlations between personality and class behaviour.

In web-based learning, personality explains some of the variability in students' course enrolment. For instance, researchers suggest that web-based courses appeal more to introverted learners (Clark and Schroth 2010), who show more positive attitudes to, and greater success in, web-based learning environments, compared to face-to-face learning (Clark and Schroth 2010). Moore and Kearsley (1996) found that introverted learners are more predisposed to web-based learning than extroverted learners. Biner et al. (1995) also found that learners of web-based courses tend to be more self-sufficient, introverted, lax and expedient than traditional classroom learners. Consequently, web-based learners who achieved higher grades tended to be less group-oriented and less compulsive (Navarro and Shoemaker 2000). Learners who have an internal locus of control are more successful in web-based learning programs than learners who have an external locus of control (Kanuka and Nocente 2003).

Some studies demonstrate the role of personality in learning using the Big Five model (Kanuka and Nocente 2003), that is, the five personality factors: extroversion, agreeableness, conscientiousness, neuroticism and openness to new experiences (Goldberg 1992). Each of these personality factors has six facets that further describe individual differences (Chamorro-Premuzic and Furnham 2003). However, the majority of studies that use the Big Five model use these five broader constructs (instead of the 30 facets) to assess personality

(Clark and Schroth 2010). Farsides and Woodfield (2003) reviewed a number of articles that examined the relationships of the Big Five factors to academic performance. Kaufman et al. (2008) studied the effects of the Big Five personality traits and motivation on academic success, and found that students who were intrinsically motivated were extroverted, agreeable, conscientious and open to new experiences (Clark and Schroth 2010). Students who were extrinsically motivated were extroverted and lacked emotional stability (Kaufman et al. 2008). Besides the Big Five model, prior research also used other personality models; namely, the Millon Index of Personality Styles (MIPS), in order to study the relationship between personality types and satisfaction with web-based learning (Kanuka and Nocente 2003).

Another dominant stream of research uses MBTI to study the personality in learning (Chamorro-Premuzic and Furnham 2003). MBTI is a popularly accepted and mature personality model that has evolved over the past 70 years. In Study 3, I used the MBTI to examine the relationship between personality and m-learning activities. The following sub-section describes MBTI personality types.

5.2.3 MBTI Personality Types

Personality research, based on Carl Jung's (1921) theory, is conducted on the premise that the mental functions related to information gathering and decision-making are central to one's personality (McElroy et al. 2007). Consequently, learners can be typed according to how they perceive and form judgments (McElroy et al. 2007). In this study, learners' personality types refer to how individuals prefer to receive information, and what methods they use to process that information (Barkhi 2002). The preferences indicate the types of environments that suit the people, let them feel comfortable and that work well (Barkhi 2002).

The MBTI is the primary instrument used to capture Jung's theory of conscious psychological type (Wheeler et al. 2004). It is, as noted above, one of the most popular and reliable personality measurement instruments (Harvey 1996), which can measure an individual's personality dispositions and preferences. It classifies people, based on their self-reporting behaviour, preferences and value judgments into four dichotomies: introversion–extroversion, sensing–intuition, thinking–feeling and judgment–perception (Myers et al. 2003). Myers et al. (2003) and McPherson (1999) explain each of the four dimensions:

(1) Introversion–Extroversion (I–E): This dichotomy explains whether individuals are introverted or extroverted, and indicates how individuals gather energy. Introverts are oriented more towards the inner world of concepts and ideas. They gather energy from their own internal world of thoughts, ideas and viewpoints. Extroverts are oriented primarily to the outer world of people and things. They find themselves energised by people and activities in the world external to themselves. Some researchers use the terms reflective–oriented and action–oriented in place of introverts and extroverts (Jonassen and Grabowski 1993).

(2) Sensing–Intuition (S–N): This dichotomy explains how individuals choose to gather information or perceive the world. Sensing-type individuals prefer to rely most heavily on the five senses to observe facts or events. They react to exactly what was said rather than the implication. Intuition-type individuals prefer to perceive the world as possibilities, meanings and relationships. They rely more on hunches or insights rather than on the five senses. They are 'big picture' people who search for patterns, and they like to make sense of complexity and read between the lines.

(3) Thinking–Feeling (T–F): This dichotomy explains how individuals prefer to make decisions. Thinking-type individuals make decisions based more on logic

and objective facts. Feeling-type individuals make decisions based more on personal and social values, subjective beliefs and how actions affect other people when making decisions. Thinking-type individuals tend to be objective, whereas feeling-type individuals are more likely to have subjective bias.

(4) Judging–Perceiving (J–P): This dichotomy explains how individuals prefer to deal with the world and how they organise their lives. Judging-type individuals use either thinking or feeling, they usually seek closure and they are more orderly and planned in their behaviour. They manage their time based on schedules and prefer to make quick decisions to achieve closure. Perceiving-type individuals use either sensing or feeling and are usually more open and adaptable in lifestyle. They prefer flexibility and spontaneity and tend to cope well when unexpected situations arise.

In a review of MBTI literature on education and learning styles, DiTiberio (1996) reported that introverts like lectures and do well in computer-assisted learning, whereas extroverts prefer a collaborative learning environment. Intuition-type learners generally perform better than sensing-type learners on standardised tests of verbal and mathematical reasoning. Sensing- and judging-type learners persist and learn in classrooms at levels equal to intuition-type learners, outperforming them in clinical situations. Cooper and Miller (1991)

found that students generally wanted to learn in a sensing style. Harrington and Loffredo (2010) found that introverts preferred web-based learning, while extroverts preferred face-to-face classes.

Dewar and Whittington (2000) studied how MBTI types relate to web-based learning experiences among 21 graduate students. They found that both introverts and extroverts experienced the web-based learning environment as appealing, but for different reasons, and the same tendency could be observed for the judging- and perceiving-type learners. Dewar and Whittington (2000) only had three sensing-type learners in their study, so useful information could not be gathered on sensing versus intuition preferences for web-based learning (Harrington and Loffredo 2010). The feeling-type learners preferred face-to-face instruction and described web-based communication as cold and impersonal, whereas the thinking-type learners preferred the web-based learning environment because they enjoyed online discussion forums. Dewar and Whittington (2000) also noted that the feeling-type learners tended to use informal areas for posting, whereas the thinking-type learners tended to use the more formal areas. Informal areas were more attractive to the feeling-type learners than to the thinking-type learners because the former were more interested in developing relationships, and the informal areas were conducive to developing relationships. In a similar study, Lucas (2007) observed

differences in the thinking–feeling dimension in an examination of 47 students in two web-based courses. In contrast to Dewar and Whittington's (2000) findings, Lucas (2007) found that the feeling-type learners were more satisfied than the thinking-type learners in learner-to-learner and learner-to-content interactions.

5.3 Hypotheses Development

Study 3 focuses on learning activities stimulated by text messaging. Learners in Study 3 use a web-based learning platform to access teaching materials. Even though the use of text messaging has previously been proposed for education purposes, my question focuses on whether text messaging can be used to stimulate learners to access the web-based learning platform more frequently. I also explore whether learners' personality types influence their responses to text messages. Most personalisation algorithms are based on individuals' past activities, whereas my work is a pioneering effort to use individual personality types to generate personalised content. I use the MBTI to measure personality type because it comprises four dichotomies that cover the key aspects of how individuals perceive and judge information, and it has been used in traditional education research (Cooper and Miller 1991).

In Study 3, I develop hypotheses on how each of the four MBTI personality dimensions influences learners' reactions to m-learning messages, based on my extrapolations from Myers et al. (2003) and Myers and Myers (1995) to the context of Study 3. I first examine the extrovert–introvert dimension, which describes where individuals focus their attention and get their energy. Extroverts (E) like to spend time in the outer world of people and things; they feel comfortable in groups and like working in them. Their minds are outwardly directed and they follow the events in their immediate environments. Their conduct is always governed by objective conditions. Extroverts prefer collaborative learning environments, and they often depend on the external world for suggestions on how to proceed in the future. They are goal-oriented and stimulus hungry, and hustle-and-bustle may be needed to trigger their actions. Conversely, introverts (I) attend to their inner world of ideas, feel comfortable being alone and like to do things on their own. They are inwardly directed and their subjective values govern their concern in matters of importance to them. They are frequently unaware of the objective environment and their interest and attention are engrossed by inner events. Their real world is the inner world of ideas and understanding. Consequently, introverts prefer reflective observation, and the hustle-and-bustle interrupts their concentration. Since extroverts like social interactions and respond to external stimulus, I anticipate that extroverts are more likely than introverts to

respond to m-learning messages that invite them to access course materials. I hypothesise that:

> *H1: Compared with introverts, extroverts are more likely to have a positive attitude towards m-learning.*

Sensing–intuition explains how individuals process information. Sensing types (S) pay attention to facts and physical reality; they start with facts and then form a big picture. They are very much aware of the events that occur in their external environment. They are dependent upon their physical surroundings (observant) and want to do what other people do (imitative). Practical presentations are likely to encourage sensing types to learn. They like the 'what' and 'how' of practical application. Intuition types (N) are interested in new things, like to see the big picture and then uncover the facts. They are imaginative, independent of their physical surroundings and quite indifferent to what other people do. Theoretical presentations are likely to excite intuitive learners. They like the principle, the theory and the why. As sensing types pay attention to facts and realities, I anticipate that they are more likely to pay attention to m-learning messages, and are more likely to respond to m-learning messages that invite them to participate in learning compared to intuitive learners. Hence, I hypothesise that:

H2: Compared with intuitive learners, sensing learners are more likely to have a positive attitude towards m-learning.

Feeling–thinking explains how individuals make human-related decisions. Thinking types (T) use objective principles and impersonal facts to make decisions. They are more interested in subject matter than in human relationships, and they value logic over sentiment. They are analytical, methodical and 'serialist' (learners). Since they prefer fact orientation and putting things into logical order, they work best if approached from a systematic perspective. Feeling types (F) give more scores to personal concerns. They are more interested in people than in things, and they value sentiment above logic. They like harmony, are people-oriented and respond more easily to people's values. Feeling types work best if their field dependence and concern for care are honoured. As thinking types use objective principles and impersonal facts to make decisions, I anticipate that they are more likely than feeling learners to respond to m-learning messages that invite them to participate in learning. I hypothesise that:

H3: Compared with feeling learners, thinking learners are more likely to have a positive attitude towards m-learning.

Judging–perceiving explains how individuals organise their lives. Judging types (J) prefer a more structured and decided lifestyle, and are purposeful and more

decisive than curious. They are self-regimented and like to live according to schedules, standards and customs. They want to settle matters as promptly as possible so that they can plan ahead and be prepared. They are pleased when a task is completed and off their minds, and they prefer planning; that is, they like to know where they are going and when they will get there (exacting). They like it when an instructor presents a plan, and they tend to follow it as given. Conversely, perceiving types (P) prefer a more flexible and adaptable lifestyle. They are adaptive, tolerant and more curious than decisive. They live in the present and can better adjust to the accidental and the unexpected. They can skilfully handle the unexpected, but may not make an effective choice among priorities in life. They are empirical (ready for anything), enjoy new experiences and they like to start something new, until the newness wears off. They like to keep decisions open for as long as possible, because they want to know more about it. They want their natural curiosity to remain alive and they prefer the flexibility to wait and see without constraints. Presumably, judging learners prefer to follow an instructor's defined work plan in order to complete the learning materials. Conversely, perceiving learners like to set up their own plans. Hence, I anticipate that judging learners are more likely to respond to m-learning messages that invite them to access course materials than perceiving learners. I hypothesise that:

H4: Compared with perceiving learners, judging learners are more likely to have a positive attitude towards m-learning.

Technology acceptance studies have established that behavioural intention to use an information system is influenced by attitudes towards using the system (Davis et al. 1989). An attitude towards behaviour describes the positive or negative feeling towards that behaviour. It is the degree to which an individual is interested in a specific system that has a direct effect on his or her intention to use that system (Davis et al. 1989). Individuals form an intention to conduct behaviour towards which they have a positive attitude (Davis et al. 1989). Using the same logic, learners would want to conduct an m-learning behaviour that is in accordance with their attitude. Hence, I anticipate that learners who have a positive attitude towards m-learning will have a higher intention to use m-learning than those who have a negative attitude. Thus, I hypothesise that:

H5: A positive attitude towards m-learning will lead to a strong intention to use it.

Technology acceptance studies have established that the actual usage of an information system is influenced by the behavioural intention to use that system (Venkatesh et al. 2003). Individuals are likely to use a system when influenced by a strong intention (Venkatesh et al. 2003). The extent to which a system will be used over a fixed unit of time is influenced by an intention

(Davis et al. 1989). Hence, I anticipate that behavioural intention will have a significant positive influence on the actual access of course materials, and I hypothesise that:

> *H6: A strong intention to access course materials will lead to actual access of course materials.*

Figure 5.1 depicts my research model, and for the purposes of testing the model a field study had been conducted which involved recruitment of 217 participants and collection of their data during a 10-week period. The research design for Study 3 is described in Section 5.4.

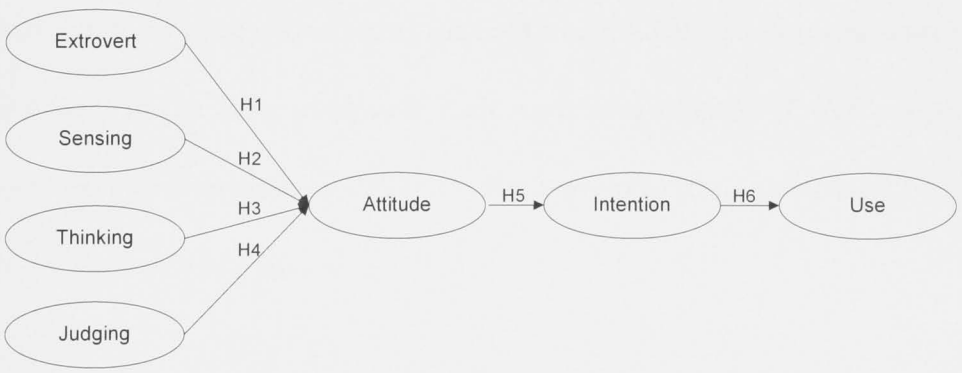


Figure 5.1: M-learning research model

5.4 METHODOLOGY

5.4.1 PARTICIPANTS

The target participants were university students from an introductory course on MIS. These students were authentic participants because they were learners. Generally, they accessed their lecture materials on WebCT—a teaching and learning management platform adopted by the university. The field study spanned a 10-week period for which a total of 217 participants (139 males and 78 females; average age = 18.25 years) were recruited, which was equivalent to 71% of the students who enrolled in the captioned courses. All students were active mobile phone users. During the field study, 4,340 SMS recommendations were sent to the 217 participants. Each participant received 20 SMS learning reminders (on average, two SMS reminders a week) to invite them to access the WebCT course materials.

5.4.2 THE FIELD STUDY

For the purposes of the study, an m-learning system was developed, which sent SMSs to registered learners. Flyers were distributed in the classroom to recruit undergraduate students in the Introduction of Management Information Systems course to participate in the study. The respondents would come to a

room to fill in a paper registration form. During registration, they also completed an MBTI test, which took approximately 45 minutes to complete. There were many types of MBTI tests. For this study, the copyrightable MBTI self-scorable Form M was used, which measured four dimensions of participants' personalities: extrovert–introvert, sensing–intuition, thinking–feeling and judging–perceiving. Throughout the semester, the participants received SMS reminders to access teaching materials, to prepare quizzes and to work on assignment submission deadlines. The reminders were sent twice a week, on Monday, Wednesday and/or Friday. Examples of the content of the text messages were as follows: 'Content, on XXX topic, is available on WebCT. It is important. Please read', or 'Your lecturer has posted messages in the discussion forum. Enjoy'. The participants' logon and page access on WebCT were tracked. At the end of every two weeks, the participants logged onto the website to complete a questionnaire. In the questionnaire, the participants reported their attitude towards, and intention to use, the m-learning system. There were three statements to answer relating to attitude: 'Using mobile SMS to facilitate my learning was a pleasant experience', 'Using mobile SMS to support my learning was a good experience', and 'Overall, I liked mobile SMS'. There were also two statements on usage intention: 'I predict I would continue using mobile SMS learning', and 'I plan to continue using mobile SMS learning'.

The entire field study spanned a period of around 10 weeks, and the findings were reported in an article of which I was the lead author.

5.5 Findings

In an MBTI test, a participant completed 93 questions on basic patterns of human functionality, preferred feeling and acting (i.e., personality) as equally legitimate dichotomous responses. These 93 questions were summed to form four scores. Each of the four scores ranged from 0 to 16, and corresponded to the four dichotomies: extroversion–introversion, sensing–intuition, thinking–feeling and judgment–perception. I calculated the four scores one by one. For each score, I performed median splitting to divide the sample into two groups, and I used a binary variable (four binary variables for all four dichotomies) to categorise participants.

I analysed the four dichotomies one by one. For the first dichotomy, the introversion (0) to extroversion (16) scores ranged from 0 to 16. The mean of the introversion–extroversion scores for the participants was 8.6. I used a median split to divide my participants into two groups: introvert learners and extrovert learners. There were 102 introverted learners and 115 extroverted learners. As some learners had equal scores, the two group sizes were not even. I used a binary variable to code this dichotomy. The 102 introverted learners

were given a value of '0' and the 115 extroverted learners were given a value of '1'.

For the second dichotomy, the intuition (0) to sensing (16) scores also ranged from 0 to 16. The mean of the sensing–intuition scores for the participants was 7.8. I used a median split to divide the participants into two groups: intuitive learners and sensing-type learners. There were 126 intuitive learners and 91 sensing-type learners. Similar to the description on extroversion–introversion, some learners had equal scores, so the two group sizes were not even. I used another binary variable to code this dichotomy. The 126 intuitive learners were given a value of '0' and the 91 sensing-type learners were given a value of '1'.

For the third dichotomy, the feeling (0) to thinking (16) scores also ranged from 0 to 16. The mean of the thinking–feeling scores for the participants was 8.5. I used a median split to divide the participants into two groups: feeling-type learners and thinking-type learners. There were 109 feeling-type learners and 108 thinking-type learners. I used the third binary variable to code this dichotomy. The 109 feeling-type learners were given a value of '0' and the 108 thinking-type learners were given a value of '1'.

For the last dichotomy, the perceiving (0) to judging (16) scores also ranged from 0 to 16. The mean of the judging–perceiving scores for the participants

was 8.1. I used a median split to divide the participants into two groups: perceiving-type learners and judging-type learners. There were 113 perceiving-type learners and 104 judging-type learners. I used the fourth binary variable to code this dichotomy. The 113 perceiving-type learners were given a value of '0' and the 104 judging-type learners were given a value of '1'.

Figures 5.2 to 5.5 present the descriptive statistics. The access (count) describes how many times a participant logged on to WebCT to access the learning materials after receiving the SMS. The time spent (minutes) describes the average duration of WebCT logon sessions.

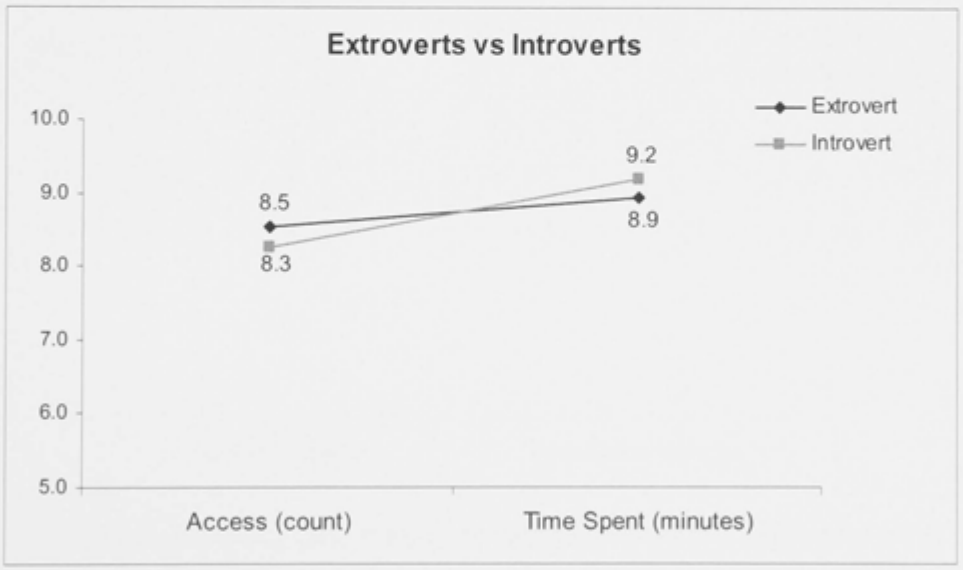


Figure 5.2: Learning activities by extroverts and introverts

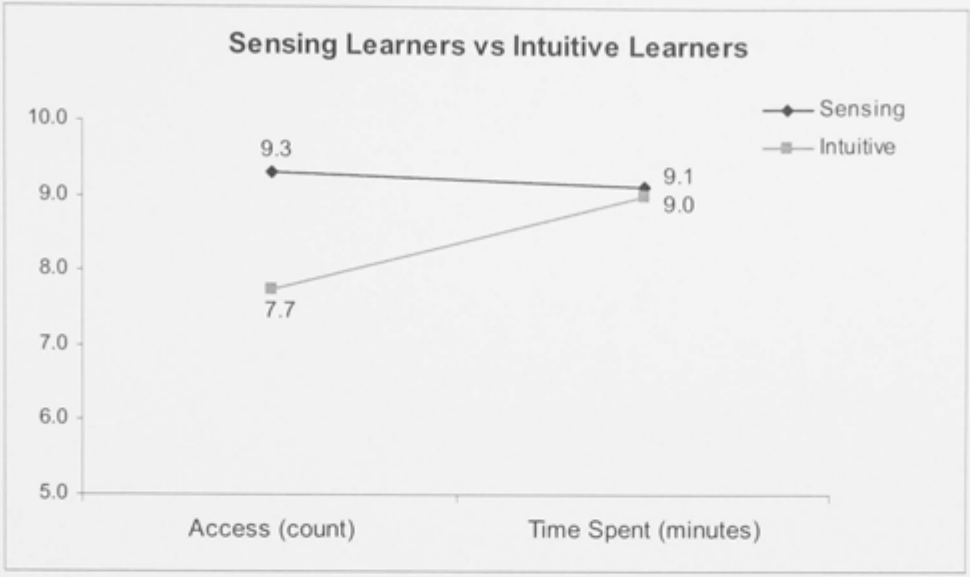


Figure 5.3: Learning activities by sensing learners and intuitive learners

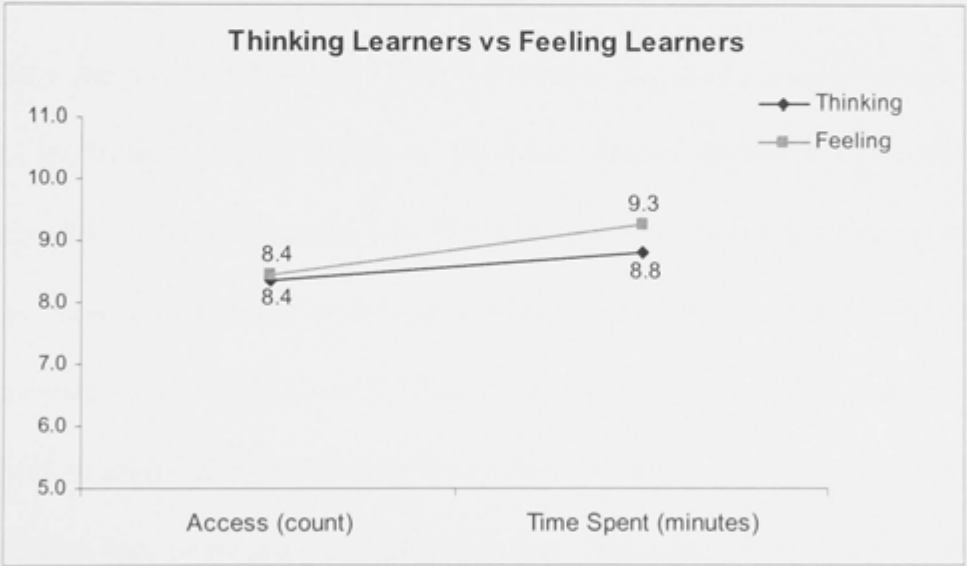


Figure 5.4: Learning activities by thinking learners and feeling learners

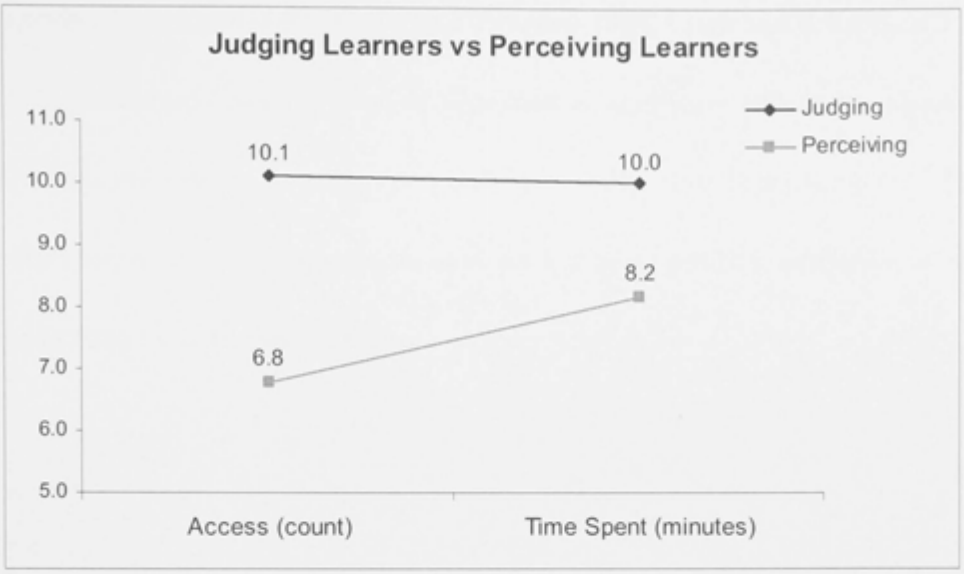
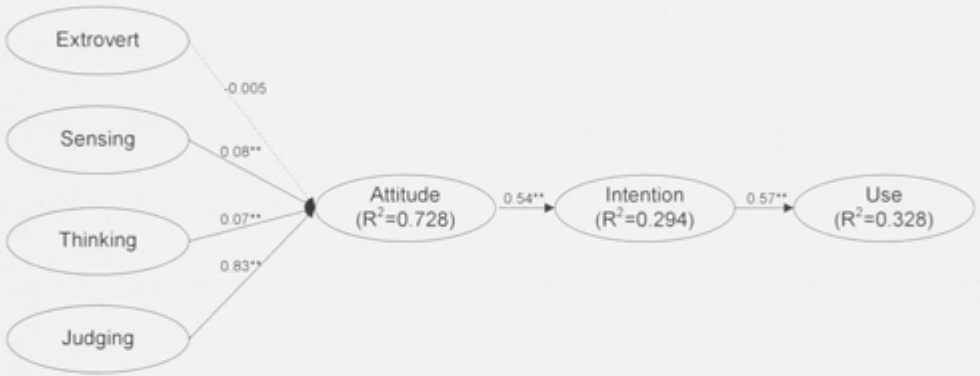


Figure 5.5: Learning activities by judging learners and perceiving learners

To analyse the effects of MBTI constructs on the m-learning adoption, I used PLS to test my model. Figure 5.6 depicts the standardised path coefficients and the explained construct variances. The total variance explained by learners' attitudes towards m-learning was 72.8%. Surprisingly, being an extrovert did not have a significant effect on a learner's attitude towards m-learning materials ($\beta = -0.005$, $p > 0.10$); thus, H1 was not supported. This means that there is insufficient evidence to claim that extroverts have a more positive attitude than introverts towards m-learning. Although this finding does not support my hypothesis, it is consistent with Dewar and Whittington's (2000) study, where it was found that web-based learning appealed to both extroverts and introverts. The results also lean towards some other previous studies, where researchers found that introverts were more inclined to use e-learning

materials than extroverts (Moore and Kearsley 1996, Clark and Schroth 2010). As hypothesised, being a sensing type had a significant effect on learners' attitudes towards m-learning (β = 0.08, p < 0.01), thus supporting H2. The results show that sensing-type learners have a more positive attitude towards m-learning than intuitive learners.



Notes: **p < 0.01, *p < 0.05. Dotted line indicates insignificant influence.

Figure 5.6: Structural model

Being a thinking type had a significant effect on learners' attitudes towards m-learning (β = 0.07, p < 0.01), thus supporting H3. The results show that thinking-type learners have a more positive attitude towards m-learning than feeling-type learners. Being a judging type had a significant effect on learners' attitudes towards m-learning (β = 0.83, p < 0.01), thus supporting H4. The results showed that judging-type learners had a more positive attitude towards m-learning than perceiving-type learners.

The total variance explained by the intention to use m-learning was 29.4%. As hypothesised, a positive attitude towards m-learning had a significant effect on learners' intentions to access m-learning materials (β = 0.54, p < 0.01), thus supporting H5. The results support prior technology acceptance literature that suggested that attitude was a strong determinant of the intention to use a service (Davis et al. 1989). The total variance explained by actual access to m-learning materials was 32.8%. Learners' strong intentions to access m-learning materials (β = 0.57, p < 0.01) led to actual access of m-learning materials, thus supporting H6. The results support prior technology acceptance literature that suggested that intention was a strong determinant of the actual use of a service (Venkatesh et al. 2003).

5.6 Discussion

5.6.1 Theoretical Contributions

Study 3 contributes to the existing literature in several ways. First, the study contributes to the 'coupling' (Orton and Weick 1990) literature by adding a perspective on how m-learning messages can be used in an effective manner for education. Roschelle (2003) and Naismith et al. (2004) suggested that, by effectively coupling the information world with the social world, learning gains could be significant. Roschelle (2003) called for more research to unlock

the value of mobile devices for learning. He suggested that a clear understanding was needed of how wireless networks meet the requirements and desires of education and teaching. In his opinion, 'pedagogical applications' are not well developed due to the wrong understanding of technologies and social practices, and due to ignoring the potential benefits that mobile and wireless technologies can bring. This study generally helps to understand coupling across informatic and social worlds in m-learning, and answers the issues raised by Roschelle (2003).

Second, this study responds to the call for more research on mobile learning in education (Ngai and Gunasekaran 2007). It contributes to a better understanding of text messaging-based learning to pedagogically use text messaging in order to stimulate different learning activities. Text messaging services, which is a text-based and lean (low in information richness) medium, is more suitable to augment rather than substitute face-to-face communication (Rau et al. 2008). Text messaging can help learners to express themselves with less inhibition by reducing pressure upon them through the reduction in socio-emotional cues (Rau et al. 2008). Consequently, it encourages more collaborative behaviours and learners reportedly feel less embarrassed to seek help than in traditional classrooms (Kitsantas and Chow 2007). Text messaging is widely used due to its mobility, flexibility, immediacy, high social presence

(due to its informal nature) and pervasiveness (Rau et al. 2008). When the instructor communicates with the student via text message, it is expected to result in a better relationship, enhanced cohesion, higher learner motivation and effective learning (Kitsantas and Chow 2007). This study sheds light on the clearer identification of the separate roles of text messaging-based learning and Internet-based learning, and the ties that bind these together to enhance learning experiences. It also contributes to an understanding of the 'surprising lack of surface resemblance between enabling (mobile) technology and desirable social practices of learning' (Roschelle 2003).

Third, this study provides information to researchers and technology designers on the effectiveness of an m-learning function: personalisation. Personalisation has been widely adopted in e-commerce (Tam and Ho 2005, Tam and Ho 2006). This study is a pioneering attempt to examine the use of personalisation in learning. My findings confirm that personalised learning should take users' characteristics, that is, personalities, into consideration. I examined whether users' MBTI personality types influence their learning preferences.

Fourth, the research in this study adds to emerging learner–system interaction literature (Hillman et al. 1994, Sia et al. 1997, Khalifa and Kwok 1999). Learner–system, or learner–content, literature posit that the connection

between learner and learning material is influenced by the nature of the subject matter, such as factual–procedural, qualitative–quantitative and constructivist–objectivist courses (Arbaugh and Benbunan-Fich 2007). Researchers suggest that, in web-based learning environments, learner–interface or learner–system interaction is critical to individual learning experiences (Hillman et al. 1994) and computer-supported group learning (Sia et al. 1997). This study responds to the call for more research on understanding learners' engagement in web-based environments to consider additional intervening variables (Arbaugh and Benbunan-Fich 2007). It highlights the role of personality in web-based learners' engagement with m-learning.

Fifth, this study adds to the rich literature on technology acceptance by highlighting the importance of personality traits as antecedents of technology acceptance dependent constructs, attitude and behaviour (Venkatesh et al. 2003). Specifically, it finds that learners' personality traits are important determinants of users' acceptance of m-learning technologies.

Sixth, this study contributes to the technology-mediated learning literature by expanding the breadth of traditional stimulus-response perspectives on learning by adding personality in an m-learning context. Traditionally, the majority of education research has tried to establish a direct cause–effect relationship

between technology (stimulus) and learning outcomes (responses), while ignoring the broad context within which learning occurs (Alavi and Leidner 2001). Consequently, Alavi and Leidner (2001) called for more research on how various technology-mediated learning environments affect learners' psychology and learning outcomes. Without knowledge of the learners' psychology that lies behind learning in innovative learning environments, learning outcomes cannot be achieved. In the context of this study, learners' psychology refers to learners' personalities or MBTI types. The study deepens our understanding of the m-learning phenomenon and informs the design of effective SMS-based learning environments by shedding light on learners' personalities.

5.6.2 Practical Implications

Study 3 will provide several vital outcomes for businesses, educators and technology designers. First, my findings will help lecturers understand the teaching opportunities associated with mobile text messaging. It also provides an opportunity for businesses to disseminate teaching messages to their employees. Competition within the business world is keen, and employee training is a key attraction and retention strategy. From 2001 to 2005, the number of employees in Australia that completed training courses increased from 4.8 million (42%) to 5.3 million (48%) (Australian Bureau of Statistics

(ABS) 2009). This statistic indicates how crucial staff training is to businesses. At the same time, more and more employees work at home. According to the ABS, 2.3 million employees (24% of 9.4 million) worked some hours at home in 2006, while 8% of employees only worked at home and 36% spent time travelling for work (ABS 2009). The number of home workers and travelling workers is increasing, but how can businesses provide training for these employees? In this environment, mobile training is an increasingly important business development strategy. Study 3 provides a first step to understanding how to use mobile devices—even a very simple function such as text messaging—to stimulate people to learn. My findings provide instructors with ideas on how learners react to learning through mobile messaging.

Second, this study helps educators (e.g., in high schools, vocational training institutions and universities) to understand how to leverage the potential of the mobile communication channel. Nowadays, teaching is not easy. According to a report by the University of Melbourne, full-time university students spend more time in paid work, and fewer of them study on weekends. The report also finds that it is harder to motivate students to learn. Study 3 explores a new pedagogical practice—shifting the teaching platform to mobile devices—which may lead to affective learning. M-learning delivers teaching content to an identifiable device; hence, it can be personalised. For instance, teaching

materials, training schedules and quizzes can be tailored to individuals and even matched with their personality types. Learners can receive reminders via mobile messages. The study provides preliminary findings on the effects of personalised m-learning.

Last, this study provides information to technology designers on the usefulness of mobile messages for learning. Researchers have suggested the need to adopt a 'critical attitude to the economic plausibility' of an m-learning platform that will 'run all the best pedagogical applications' (Roschelle 2003, p. 270). Study 3 is a step towards driving raw technologies, such as text messaging services, which have arrived in classrooms, towards a common, scalable and feasible pedagogical platform. Given that technology can both enable and hinder learning innovations, this study helps to determine whether text messaging is an appropriate teaching and learning application.

5.6.3 LIMITATIONS

Study 3 has several limitations. First, the field study only spanned a 10-week period. It is inconclusive whether the effects observed in this study would have a long-term effect. A longitudinal study, in future, could explore whether the ability of mobile messaging to stimulate learners to access various teaching content diminishes over time. Second, only full-time students were used in the

study. Part-time students who are employed in businesses may have different learning preferences and expected outcomes compared to full-time students. As they juggle the roles of student and employee, their time may be less flexible and their personalities that affect learning may differ from those of full-time students. More effort should be invested into exploring the effects of various user characteristics or traits on users' learning preferences. It would also be useful to test the relationships found in this thesis in different m-learning contexts involving different participants, such as part-time students, full-time workers and visiting learners at museums, to determine whether the same findings are observed. Third, I only studied one feature of m-learning: SMS to stimulate learning. Future research can also examine the effects of different mobile devices and m-learning tools on stimulating learning activities.

5.7 Summary of Study 3

M-learning will play a significant role in future education, as it has the potential to provide learners with interesting and relevant learning experiences. Although businesses and education institutes invest heavily in m-learning, there has been little research into its effectiveness.

Study 3 examined the effects of mobile messaging on the stimulation of students' learning activities. Specifically, I examined how learners' personalities

influence their reactions to mobile messaging. Based upon a field study of 217 participants, I confirmed that the personalities of learners did affect their attitude and behaviour towards m-learning.

Overall, the study contributes to theory by highlighting the effects of personality on m-learning behaviour, and it contributes to practice by highlighting the use of mobile messaging to stimulate learning.

Chapter 6

Conclusion

This thesis signifies an important step in the testing of theories related to demographics, perceptions and personality traits in the use of MDSs. As the thesis is based on three studies, I will present concluding remarks on each study before setting out the theoretical contributions and practical implications of the thesis as a whole.

Study 1 investigated gender and age divides in the use of various MDSs. In general, the study finds that the usage of various MDSs is influenced by both gender and age. Men are more likely than women to use MDSs, except for shopping, chatting and social networking, while young people are more likely than their older counterparts to use MDSs.

The findings of Study 1 are useful to both academia and business, as it will help them to better understand the role of gender and age differences in MDS usage, and enable them to tailor different MDSs to different gender and age groups. The findings are also useful for marketing agents, mobile network operators, and content and application providers, in developing market segmentation practices and targeting strategies through their improved knowledge of MDS users' distinct socio-demographic characteristics.

Study 2 examined a key MDS application – m-banking - and it was divided into 2 parts. Study 2 (Part I) identified 65 m-banking articles published between

January 2000 and June 2010, and classified them using the framework developed by Ngai and Gunasekaran (2007). It is a timely indicative review given that, to the best of my knowledge, it is the first review article on m-banking. It is apparent from the review that m-banking has garnered the attention of practitioners and academics alike in recent years, and research activity in the m-banking domain has clearly increased since 2007. There are, however, significant opportunities for further research into this area. One of those research areas is the switch from other channels to mobile channels for banking, which forms the subject of Study 2 (Part II).

Study 2 (Part II) examined the users' intentions to switch to m-banking from other channels, and as part of that examination, it investigated the effects of perceived mobility, relative advantage, complexity, self-efficacy, financial resources and risk on behavioural intention to switch. It used concepts from expectancy theory—valence, expectancy and instrumentality—to categorise the variables and to develop the hypotheses. The use of expectancy theory as a theoretical frame enabled me to put the variables into perspective and to identify more clearly the role each variable plays in switching.

Study 2 (Part II) represents a first step towards understanding technology-enabled switching behaviour. It sheds lights on the factors influencing m-

banking switching behaviour for banks and mobile service providers. This improved understanding of why mobile users switch to m-banking will be of benefit to businesses, as many SST advancements are likely to take place over the next few years, and banks and MDS providers will be increasingly willing to migrate users towards mobile SSTs.

Study 3 investigated the potential of another key MDS - m-learning - to facilitate teaching among learners in businesses and education institutes. It proposed to use a text messaging service as a tool to stimulate learners' activities, and examined whether learners' personalities influenced their reactions to accessing course materials via m-learning messages. The MBTI was used to categorise learners into different personality groups. During a field study with 217 students, it was found that learners of different personalities showed different levels of activities when receiving m-learning messages.

This thesis has a number of theoretical contributions. First, the findings of significant differences across age and gender groups in the use of various MDSs do not only confirm the role of widely researched demographics in the adoption of technology; it also extends prior findings by highlighting gender and age differences in the use of different categories of MDSs such as communication, entertainment and transactional services. The majority of

MDSs (e.g., entertainment services) are male dominated. However, some services (e.g., transactional services) are gender-neutral, and some services are female-dominated. Younger people use MDSs more than their older counterparts in all categories of MDSs.

Second, the development of a theory, built on expectancy theory, to test users who switch from one channel to another to conduct MDS activities via technology-mediated alternatives, is a novel approach in the context of MDSs. It overcame the current IS research trend of examining specific technologies in isolation by examining the channel-switching issue in MDSs. My study provided a holistic picture of mobile users' behaviour, where individuals are not restricted to exclusively utilising a single channel of service.

Third, the theorising of personality effects on m-learning behaviour through the examination of learners' reactions to text messages to stimulate learning is a pioneering effort in respect of personalisation in learning. Most personalisation literature is based on individuals' past activities. In this thesis, the MBTI personality types were used to examine whether learners' personality traits influenced their learning preferences, and the findings confirm that personalised learning should take users' personalities into consideration.

This thesis has practical implications too. First, it will help mobile service providers to better understand the role of demographic differences in MDS usage, and to better tailor different MDSs to different gender and age groups. It will assist marketing agents, mobile network operators, mobile content and application developers, and financial service providers in developing market segmentation practices and targeting strategies through their improved knowledge of users' distinct socio-demographic characteristics.

Relatively lower use of MDSs among women and the older population, compared to their younger counterparts, implies that mobile applications should be made more attractive to women and older people. Producers, designers and policymakers need to address design, culture, language and identity issues in line with demographics, while designing and delivering mobile applications and services. Early adopters' profiles identified in this thesis, in terms of their basic demographic characteristics, will also be useful to MDS providers in designing effective target market strategies.

Second, with the proliferation of SSTs and the growth of the online services industry, this thesis will be valuable to organisations, wireless site designers and consumers alike. It will have significant diagnostic value to achieve organisational objectives in both early and later stages of the adoption process

of MDSs. The results of this thesis will be important for managers in retailing industries, who are considering either the implementation or expansion of the mobile channel as an SST in their service delivery, as it will shed light on factors that might be salient to targeted users. In other words, it will help managers better understand mobile user behaviour and invest in 'suitable' mobile applications and infrastructure.

Third, this thesis provides vital information for businesses, educators and technology designers by highlighting the use of mobile text messaging to stimulate learning. It provides an important first step to understanding the usage of mobile devices, even a very simple function such as text messaging, to stimulate people to learn. My findings provide instructors with ideas on how learners may react to learning through mobile messaging. The findings also help lecturers understand the teaching opportunities associated with mobile text messaging. They also provide an opportunity for businesses to disseminate teaching messages to their employees.

Fourth, this thesis is a step towards exploring a new pedagogical practice—shifting the teaching platform to mobile devices—which may lead to effective learning. M-learning delivers teaching content to an identifiable device; hence, it can be personalised. For instance, teaching materials, training schedules and

quizzes can be tailored for individuals and even matched with their personality types. Learners can receive reminders via mobile messages. This thesis provides preliminary findings on the effects of personalised m-learning. It is a step towards driving raw technologies, such as text messaging services, which have arrived in classrooms, towards a common, scalable and feasible pedagogical platform. Given that technology can both enable and hinder innovation in learning, this thesis helps determine whether a text messaging service in learning is an appropriate teaching and learning application.

This thesis is not without limitations. It contains studies of only two MDS applications: m-banking and m-learning. Future research can examine the effects of demographics, perceptions and personality traits on different mobile devices and applications. Further research should also explore the effects of various user characteristics or traits on users' MDS preferences and usage. It would also be useful to test the relationships found in the thesis in different countries, and in particular, developing countries.

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APPENDIX A

LIST OF ITEMS (M-BANKING)

(1 = Strongly Disagree; 7 = Strongly Agree)

Perceived Relative Advantage

PRA1	Using mobile banking would improve my performance in conducting banking transactions.
PRA2	I would find mobile banking useful in conducting my banking transactions.
PRA3	Mobile banking is more advantageous than conventional forms of banking.

Perceived Mobility

PM1	I can use mobile banking at any time.
PM2	I can use mobile banking from anywhere.

Perceived Complexity

PCMX1	Mobile banking would be complex to use.
PCMX2	Mobile banking might be frustrating.

Perceived Self-efficacy

PSEF1	I can easily understand the process of mobile banking.
PSEF2	I can learn the process of mobile banking easily.

Perceived Financial Resources

PFR1	There are financial barriers (e.g. having to pay for handset and communication time) to my using mobile banking.
PFR2	It would cost a lot to use mobile banking.

Perceived Risk

PR1	Using mobile banking would compromise my personal information.
PR2	I would find mobile banking not secure in conducting my banking.

Intention to Switch

SWI1	I intend to switch to mobile banking.
SWI2	I intend to change to mobile banking in the future.

APPENDIX B

QUESTIONNAIRE (M-BANKING)

PART I: GENERAL INFORMATION

Section A: Mobile Services and Banking Products

1. What do you use your mobile phone for? (Please mark all that apply)

☐ SMS

☐ MMS

☐ Accessing the Internet

☐ Banking

☐ Playing games

☐ Calculator

☐ *Other, for example:*_____

2. Which of the following banking products you currently use? (Please mark **all** that apply)

☐	Savings account	☐	Current account	☐	Fixed deposit	☐	Cheque account
☐	Personal loan	☐	Car/Home loan	☐	Overdraft account	☐	Pay utility bills
☐	Phone banking	☐	Internet banking	☐	Investment account	☐	Foreign currency account

☐	Credit card	☐	*Other, for example:*_____

Section B: Banking Channels

3. On average, how frequently do you visit your bank?

☐ Several times a day

☐ About once a day

☐ A few times a week

☐ About once a week

☐ A few times a month

☐ About once a month

☐ Less than once a month

☐ Never / almost never

4. On average, how often do you use the ATM?

☐	Several times a day	☐	About once a day	☐	A few times a week	☐	About once a week
☐	A few times a month	☐	About once a month	☐	Less than once a month	☐	Never/almost never

5. To what extent do you use the following to do banking? (Please mark **all** that apply)

	Several times a day	About once a day	A few times a week	About once a week	A few times a month	About once a month	Less than once a month	Never/ almost never
Bank Branch	□	□	□	□	□	□	□	□
ATM	□	□	□	□	□	□	□	□
Telephone	□	□	□	□	□	□	□	□
Internet	□	□	□	□	□	□	□	□
Mobile phone	□	□	□	□	□	□	□	□

6. Assuming that you have access to all of the following banking channels, rank each of the following channels (1 for most preferred, 2 for 2nd most preferred…5 for least preferred).

6a. Bank branch [ ]

6b. ATM [ ]

6c. Internet [ ]

6d. Phone [ ]

6e. Mobile phone [ ]

Section C: Banking Channels and Tasks

7. Rank banking channels for each of the following tasks (1 for most preferred, 2 for 2nd most preferred...5 for least preferred channel).

Tasks	Branch	ATM	Internet	Phone	Mobile
Example: Transfer fund.	*4*	*5*	*2*	*3*	*1*
7a. Enquire balance	[ ]	[ ]	[ ]	[ ]	[ ]
7b. Request statement	[ ]	[ ]	[ ]	[ ]	[ ]
7c. Receive threshold alert (i.e., critical transaction, balance approaching to nil, salary processed etc.)	[ ]	[ ]	[ ]	[ ]	[ ]
7d. Find Branch/ATM location	[ ]	[ ]	[ ]	[ ]	[ ]
7e. Transfer fund					
7f. Pay utility bills	[ ]	[ ]	[ ]	[ ]	[ ]
7g. Trade stocks	[ ]	[ ]	[ ]	[ ]	[ ]
7h. Purchase phone card	[ ]	[ ]	[ ]	[ ]	[ ]
7i. Send/Receive remittance	[ ]	[ ]	[ ]	[ ]	[ ]
7j. Receive credit card related	[ ]	[ ]	[ ]	[ ]	[ ]

alert					

8. Rank (1 for most preferred, 2 for 2nd most preferred...16 for least preferred) and provide a score (in between 1 to 7, inclusive) for each of the following banking tasks to reflect your intention to perform each task:

Tasks	Task ranking (1: Most preferred, 16: Least preferred, Integer only)	Score of intention to use (1: No intention, 7: Highest intention)
8a. Enquire balance	[ ]	[ ]
8b. Request statement	[ ]	[ ]
8c. Receive threshold alert (i.e., critical transaction, balance approaching to nil, salary processed etc.)	[ ]	[ ]
8d. Find Branch/ATM location	[ ]	[ ]
8e. Transfer fund	[ ]	[ ]
8f. Pay utility bills	[ ]	[ ]
8g. Trade stocks	[ ]	[ ]
8h. Purchase phone card	[ ]	[ ]

8i. Send/Receive remittance	[ ]	[ ]
8j. Receive credit card related threshold alert	[ ]	[ ]
8k. Purchase movie ticket	[ ]	[ ]
8l. Purchase and read news	[ ]	[ ]
8m. Purchase ringtone	[ ]	[ ]
8n. Purchase games	[ ]	[ ]
8o. Purchase and receive game updates, such as cricket	[ ]	[ ]
8p. Purchase and receive weather updates	[ ]	[ ]

Section D: About Yourself

9. Gender: □ Male □ Female

10. Age group:

□	Under 18	□	18–25	□	26–30	□	31–35
□	36–40	□	41–50	□	51–55	□	55+

11. What is the highest level of education you have completed?

□	Primary school	□	High school	□	HSC/Year 12	□	Some tertiary

							education
☐	Bachelor degree	☐	Master degree	☐	Doctorate	☐	Vocational/ Polytechnic
☐	*Other.* _____						

12. What is your current profession?

☐	Student	☐	Employed	☐	Unemployed	☐	Business
☐	Professional	☐	Retiree	☐	Housewife	☐	Academic
☐	Manager	☐	Executive	☐	Technician	☐	Govt. Employed
☐	*Other.*_____						

PART II: M-BANKING PERCEPTIONS

13. Relative Advantage	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
13a. Using mobile banking would improve my performance in conducting banking transactions.	☐	☐	☐	☐	☐	☐	☐
13b. I would find mobile banking useful in conducting my banking transactions.	☐	☐	☐	☐	☐	☐	☐
13c. Mobile banking is more advantageous than conventional forms of banking.	☐	☐	☐	☐	☐	☐	☐

14. *Risk*	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
14a. Using mobile banking would compromise my personal information.	☐	☐	☐	☐	☐	☐	☐

14b. I would find mobile banking not secure in conducting my banking transactions.	☐	☐	☐	☐	☐	☐	☐
14c. Mobile banking is a risky mode of banking to use.	☐	☐	☐	☐	☐	☐	☐

Perceived Financial Resources	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
15a. It would cost a lot to use mobile banking.	☐	☐	☐	☐	☐	☐	☐
15b. There are financial barriers (e.g., having to pay for handset and communication time) to my using mobile banking.	☐	☐	☐	☐	☐	☐	☐

Complexity	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
16a. Mobile banking would be complex to use.	☐	☐	☐	☐	☐	☐	☐

16b. Mobile banking would require a lot of mental effort.	□	□	□	□	□	□	□
16c. Mobile banking might be frustrating.	□	□	□	□	□	□	□

Mobility	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
17a. I can use mobile banking at any time.	□	□	□	□	□	□	□
17b. I can use mobile banking from anywhere.	□	□	□	□	□	□	□

18. Self-efficacy	Strongly Disagree						Strongly Agree
18a. I can easily understand the process of mobile banking.	□	□	□	□	□	□	□
18b. I can learn the process of mobile banking easily.	□	□	□	□	□	□	□

19. Intention to Switch	Strongly Disagree						Strongly Agree
	1	2	3	4	5	6	7
19a. I intend to switch to mobile banking.	☐	☐	☐	☐	☐	☐	☐
19b. I intend to change to mobile banking in the future.	☐	☐	☐	☐	☐	☐	☐

20. Please feel free to write your comments about mobile banking services in the space below.